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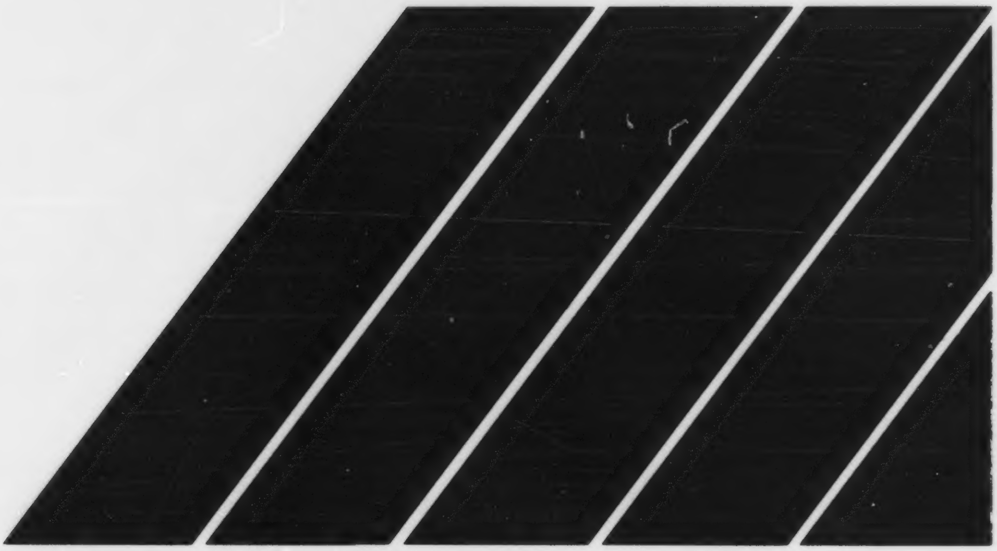
A CATALOGUE OF SMALL-SCALE COMBUSTORS FOR BIOMASS FUELS



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A CATALOGUE OF SMALL-SCALE COMBUSTORS FOR BIOMASS FUELS

PREPARED FOR:

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Energy, Mines and Resources Canada
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RÉSUMÉ

L'équipement dont il est ici question concerne la conversion en énergie thermique d'un large éventail de combustibles solides dérivés de la biomasse, par combustion dans un milieu contenant un excès d'air. Le présent catalogue d'adresse aux utilisateurs d'applications à petite échelle, c'est-à-dire dont la production d'énergie s'échelonne entre 0,1 et 21 GJ/h. Il ne traite pas des systèmes de conversion thermochimique de la biomasse en combustible de forme intermédiaire par des procédés tels que la gazéification ou la liquéfaction.

Le catalogue comporte trois sections et sa présentation a été conçue dans le but de faciliter l'association entre l'application visée et le type de systèmes approprié. D'abord, le document contient une brève description de chaque type de combustibles généralement utilisé dans le domaine de la bioénergie ainsi que les types de systèmes d'énergie actuellement disponibles. La seconde section indique à l'utilisitateur le procédé à suivre dans le choix d'un équipement et présente un guide de références à cet égard. La dernière partie contient une description des systèmes ainsi que leurs caractristiques pour chaque fournisseur et ce, par ordre alphabétique. On y trouve également une liste des experts-conseils mentionnant une expérience dans le domaine de l'énergie dérivée de la biomasse.

Les systèmes décrits sont disponibles sur le marché canadien et la plupart d'entre eux ont déjà fait leurs preuves dans l'industrie, souvent grâce à un nombre significatif d'installations présentement en fonctionnement. Les renseignements sur chacun d'eux sont tels qu'ils ont été fournis par les distributeurs. Aucune tentative n'a été faite pour en vérifier l'authenticité, l'applicabilité ou la pertinence. Par conséquent, il est possible que certains systèmes, bien qu'ils soient disponibles sur le marché, n'aient pas fait leurs preuves dans l'industrie ou même qu'ils n'aient pas été décrits de façon adéquate. De même, les compétences ainsi que les titres des experts-conseils n'ont fait l'objet d'aucune vérification.

I. INTRODUCTION

The equipment covered in this catalogue deals with the conversion of a wide variety of biomass-derived solid fuels to thermal energy via direct combustion in an excess of air. The catalogue is directed at small scale user applications in the range of 0.1 to 21 GJ/h energy output. It does not include systems for the thermochemical conversion of biomass to an intermediate fuel form by processes such as gasification or liquefaction.

The catalogue is divided into three sections and the format has been designed to hopefully allow easy matching of user application to system design. A brief description is presented covering the types of fuels commonly included in the bioenergy sector and the generic energy system designs presently available. A second section gives the user the procedures for equipment selection and presents an equipment reference guide. The final chapter contains system descriptions and characteristics for each supplier alphabetically. In addition, a list of consultants who have reported experience in the biomass energy field is provided in this section.

The systems are commercially available to potential Canadian users and the majority are industrially proven, often with a significant number of operating installations. Information is presented as supplied by the equipment distributors. No attempt has been made to screen data for authenticity, applicability or relevance. Therefore, it is possible that some systems, while commercially available, may not be industrially proven or even appropriately demonstrated. Likewise, no attempt has been made to verify the capabilities or credentials claimed by consultants.

II. BIOFUEL COMBUSTION

A. Biofuels

1. Forest Based Biofuels

The largest segment of biomass based solid fuels presently used in Canada is that derived from the extensive forest resource. Based on the origin of the biofuel, this segment can be further classified into two sectors - forest residuals and mill residues.

Forest residuals originate directly from the forest and typically require harvest/collection plus some degree of treatment to yield a suitable biofuel. Such conditioning may include size reduction (chipping, shredding, splitting, etc.) or moisture reduction (thermal drying, air-drying or seasoning). Forest residuals are produced from three main activities. Logging residues include materials left in the forest after conventional harvesting of merchantable timber. It consists of tops and branches; undersized, deformed or otherwise defective trees; sortyard and landing debris; non-commercial species; and in some cases, stumps and roots. Silvicultural treatment products are obtained prior to commercial harvesting and include thinnings, salvaged materials killed by fire, disease or natural disasters and stand conversion materials such as non-commercial trees and brush removed to facilitate reforestation. Finally, merchantable surplus of commercial materials over and above industrial fiber requirements provides the last source of forest residuals. These also include small acreage and woodlot operations where harvest of conventional timber is impractical.

Forest industry mill residues cover the byproducts associated with the processing of merchantable timber to conventional forest products. They include materials such as: bark, sawdust, solid trim, shavings, veneer clippings, yard debris, sander dust, composite board trim and various fibrous sludges. Utilized at the mill site or transported to other industrial or commercial users, these biofuels can be combusted as is or can be upgraded by further communition, drying or cleaning processes.

As suggested by the foregoing descriptions, biofuels originating from the forest possess diverse physical properties regarding size, moisture content, and inert (non-combustible) material content. While most combustion systems provide for this diversity of fuel properties, several systems have strict limitations for fuel quality. Some problematic qualities of fuels are applicable only to specific sources, such as the typically high inert material content within sort-yard residues and logs skidded on sandy soil. Thus it is important to properly classify the available fuel to assess its appropriateness to any given combustion equipment.

2. Municipal/Industrial Wastes

A second significant source of solid biomass fuels is that of municipal and industrial wastes. Municipal solid waste (MSW) is roughly 75% combustible, the largest portion being of organic origin including paper, cardboard, wood, fabric, yard debris and food residues. Industrial wastes contain biofuel components such as wood (pallets, crates), cardboard and paper.

This fuel can be utilized essentially as received (removal only of large non-combustible items), or can be upgraded to a Refuse Derived Fuel (RDF) by removal of the non-combustible materials such as glass, metal, rocks and dirt.

3. Agricultural/Food Processing Residues

A third major category of biofuels is that derived from the agricultural sector. These include field crop residues such as: cereal grain straw, stovers, chaff, corn cobs, bean residues, sugar beet tops, sunflower and tobacco stalks. Also utilized are food processing residues such as: grain screenings, hulls and husks, potato culls, nut shells and fruit pits, apple pomice, beet pulp, coffee grounds.

Recently there has been an increase in the utilization of a group of biomass derived solid prepared fuels. Known as densified biomass fuel (DBF) it is available in the form of pellets, briquettes or small logs. DBF is formed by the high pressure densification of dried, pulverized biomass either with an added binder or as a self-bonded product. DBF can be formed from almost any source of biomass but are most commonly based on wood, straw or RDF.

The logs are used in household stoves and fireplaces while pellets and briquettes are more commonly used in industrial and commercial applications.

B. Energy Forms

Thermal energy released from the biomass combustion is delivered to the appropriate end use energy demand by a variety of heat transfer media. A simple combustor provides the energy output as a hot gas flow which includes the products of combustion, evaporated fuel moisture and excess air. Energy is tranferred principally from the sensible heat of this gas flow.

The hot gases can be used directly for process applications (product drying, direct contact water heating) or can be ducted to a separate heat exchanger for transfer of the energy to a secondary heat transfer media. This can be air, water, oil or steam. Alternatively, the conversion system can be an intregal combustor/heat exchanger in which the radiant and sensible heat from the combustion process is transferred immediately to the secondary heat transfer media for delivery to the thermal load.

In comparisons of various combustion systems the term efficiency often arises. It is important to keep a reference to the efficiency bases when comparing this characteristic of various systems. For example, efficiencies of simple combustion systems producing hot dirty gas are usually expressed as overall combustion efficiency, i.e., the amount of heat present in the hot gas over the higher heating value of the fuel. This is a suitable basis for comparison for direct applications of as-produced hot gas. Other systems such as integral boilers are best characterized by overall thermal efficiency which take into account heat losses from system components not inherent in simple combustors. It is, therefore, necessary to consider losses in downstream system components not supplied with the basic combustor but necessary for the final application.

C. Equipment

1. Combustors (Hot Gas Generators)

(a) Single Chamber Combustors

Single chamber combustors are the simplest of combustors consisting of a refractory-lined furnace with a bottom grate (Figure 1). Combustion of biofuels takes place in a pile on the grate, with evolved volatiles burned above the pile. Primary combustion air is introduced through the grate while secondary combustion air is supplied through overfire ports.

Single chamber combustors evolved from simple disposal incinerators which were modified for energy recovery by passing the hot gas stream through some form of heat exchanger.

Generally, single chamber combustors work well in small capacity ranges. Because poor mixing of overfire air with combustible gases evolved from the fuel pile results when large distances are involved, performance of larger combustors becomes difficult to stabilize. In addition, turndown ratios of large units are severely limited; as low as 2:1 compared to 4:1 to 5:1 for smaller units. The typically slow response to load change of single chamber combustors is more pronounced in the larger size range.

Single chamber combustors typically can handle a wide range of fuel types and sizes. Some units are designed to burn small logs or a variety of biomass chunk fuels such as straw bales, while the more conventional types burn smaller particulate

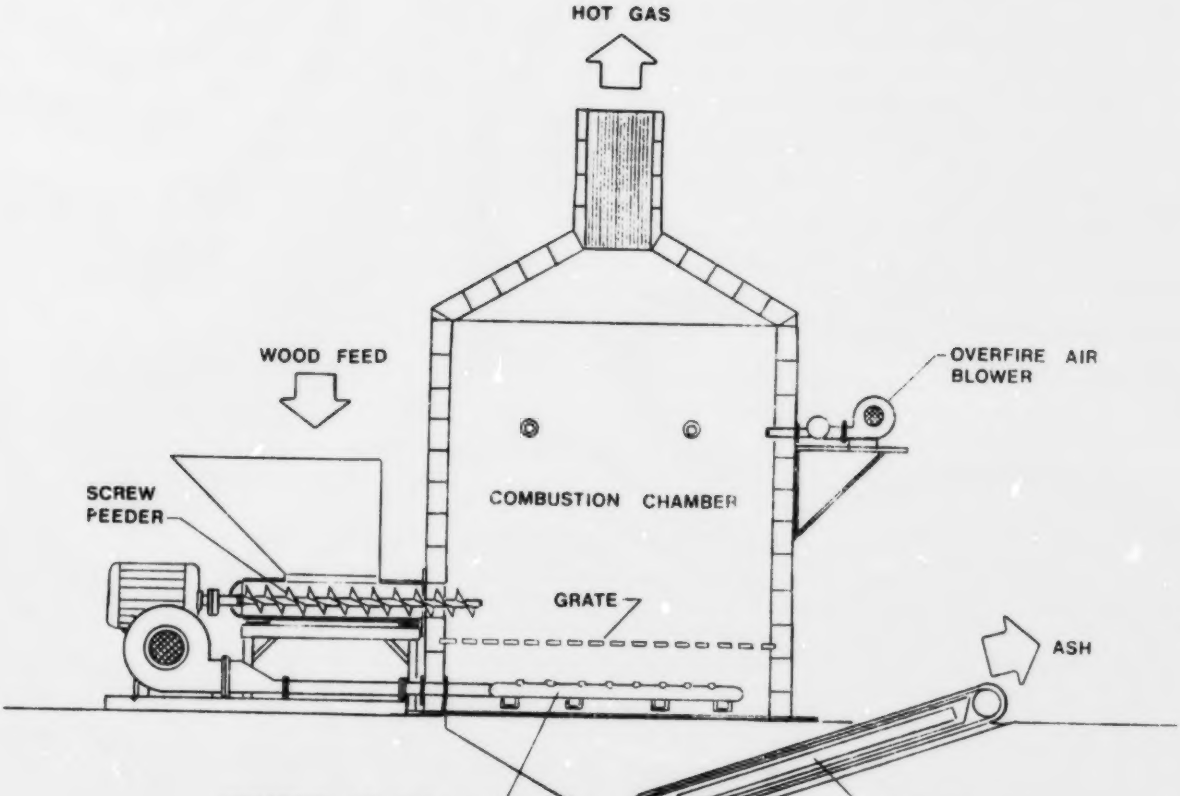
HOT GAS
WOOD FEED
OVERFIRE AIR BLOWER
SCREW FEEDER
COMBUSTION CHAMBER
GRATE
ASH
UNDERFIRE AIR PLENUM
ASH CONVEYOR

FIGURE 1 SINGLE CHAMBER COMBUSTOR

fuels. Moisture content of the fuel is not critical, most manufacturers recommend maximum moisture contents of 50% to 60%. In most cases, uniformity of fuel moisture content is the important factor, since these units do not handle sudden variations in moisture content, and are particularly susceptible to combustion problems when fine, dry fuels are injected as airborne particulates and carry-over extends the material combustion outside of the chamber.

In the case of log-size fuel firing, feeding is performed manually in batches, perhaps once or twice per shift, depending on size of the unit and energy demand. Single chamber combustors fueled by particulate fuels are normally fed by conventional mechanical systems. Typically, ash removal is performed as required, although some manufacturers offer automatic ash removal systems.

The thermal efficiency of single chamber combustors depends markedly on design and size. Units producing hot, uncleaned gas as a primary product should have efficiencies above 90%, but probably less than the average 95% for suspension burners. Some units have been reported as having efficiency values as low as 75%, undoubtedly reflecting equipment size, equipment design and extent of insulation.

Most single chamber combustors require some form of particulate emission control to reduce emission levels to meet regulatory guidelines or standards. They are similar to Dutch-oven-type boilers in their operation and can be expected to emit the same levels of particulate.

Because of the simplicity of the single chamber combustor, little supervision or operating cost is required.

(b) Multiple Chamber Combustors

Multiple chamber combustors are usually two-stage combustion units designed to distill the volatiles from the fuel and burn them in a separate chamber (Figure 2). In the primary chamber where gasification of wood and combustion of char occurs, air is provided in substoichiometric quantities from below the grate. Because of the low air flow, turbulence is reduced and very little particulate carryover occurs. A choke separates the primary chamber from the secondary chamber, where secondary air is added to complete combustion of the gas. The temperature in the secondary chamber is very much higher than in the primary chamber.

The relatively clean hot gas produced from multiple chamber combustors can be used in conjunction with hot air, hot oil, hot

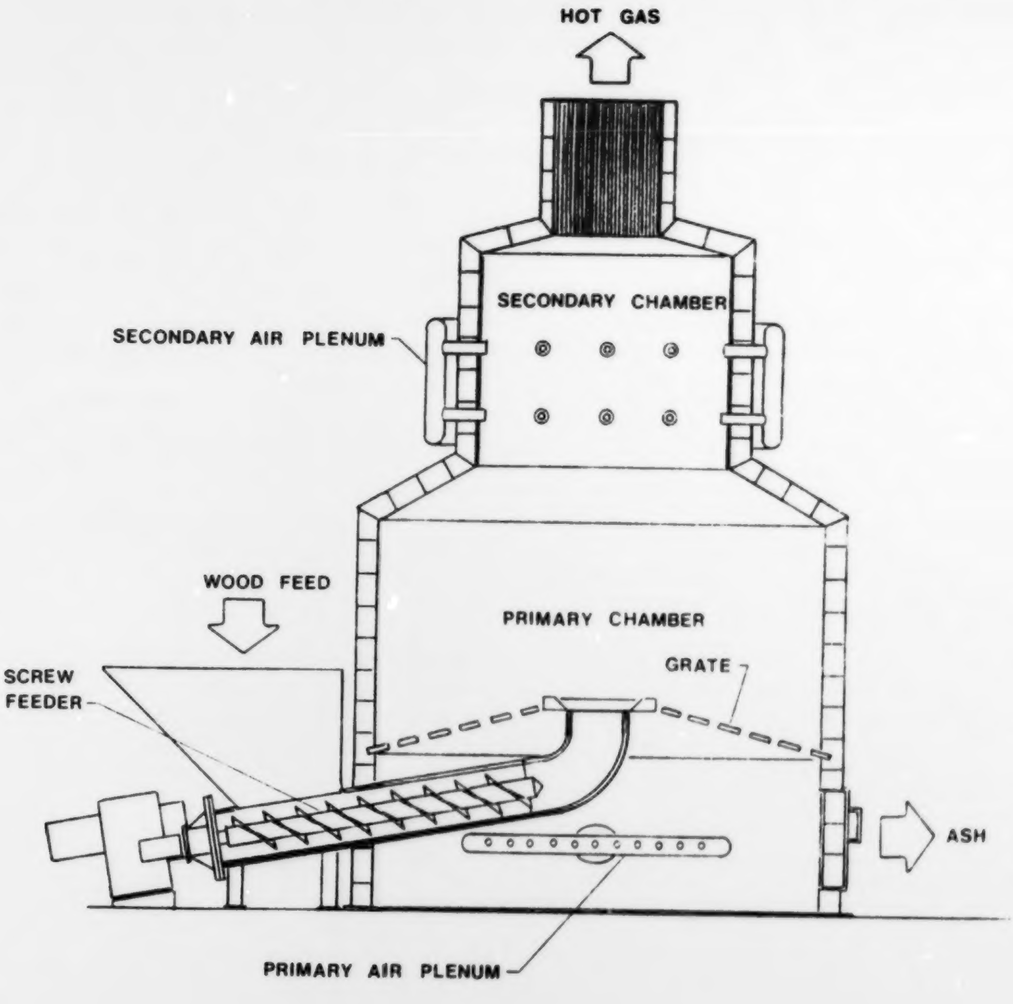
HOT GAS
SECONDARY CHAMBER
SECONDARY AIR PLENUM
WOOD FEED
PRIMARY CHAMBER
SCREW FEEDER
GRATE
ASH
PRIMARY AIR PLENUM

FIGURE 2 MULTIPLE CHAMBER COMBUSTOR

water and steam heat exchangers. In addition, the hot gas that is produced can be used for direct applications such as product drying.

Multiple chamber combustors are a substantial improvement over single chamber combustors. They are proven technology and are free of most problems common to the single chamber design.

The major advantage of multiple chamber combustors is their ability to burn wood having a moisture content up to 60% and a variety of sizes. Stable burning of the wet wood is aided by pre-heating the inlet air, radiative heating from the hot refractory, and cyclonic flow of overfire gases for good mixing of air and combustibles.

Another major advantage of multiple chamber combustors is that their particulate emissions are much lower than from single chamber combustors. Even with no emission control equipment, emissions can be as low as 46 mg/m3. The residence time of entrained particles which pass to the secondary chamber is increased with use of cyclonic flow in the secondary chamber.

Some systems provide auxiliary fuel for the secondary chamber, particularly those designed to combust municipal refuse. This feature allows for disposal of very poor quality fuels. Most wood fuels should not require supplemental fuels, except for startup.

Operation of multiple chamber combustors is usually modulated automatically by controlling wood feed rate and combustion air supply. Performance varies drastically from manufacturer to manufacturer, with claims of turndown ratios varying from 2:1 to infinity and response times ranging from 5 seconds to 5 minutes.

The thermal efficiency of multiple chamber combustors depends on the specific equipment included. Typically, a unit producing only hot, uncleaned combustion gases for a further application should have a conversion efficiency greater than 90%.

Feeding of multiple chamber combustors can be accomplished in many ways, though it is most often done with some type of undergrate stoker system. In addition, several types of ash removal systems are available as an option to manual cleanout.

2. Suspension Burners

In suspension burners, relatively clean, finely-sized, dry particles are thoroughly mixed with air and burned in suspension (Figure 3). Auxiliary burners are required and may be supplied as an

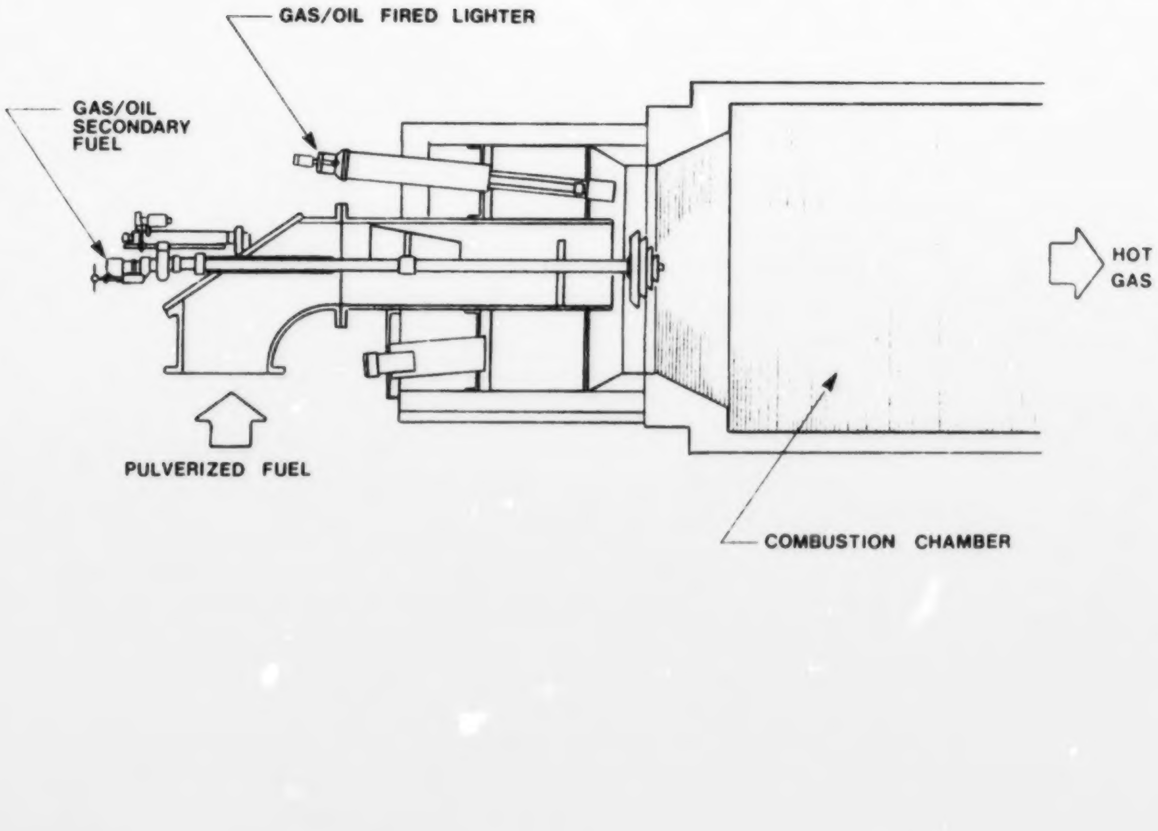
GAS/OIL FIRED LIGHTER
GAS/OIL SECONDARY FUEL
HOT GAS
PULVERIZED FUEL
COMBUSTION CHAMBER

FIGURE 3 SUSPENSION BURNER

integral part of the biofuel burner or as a separate burner. In both cases, they are fueled with either fuel oil or natural gas. The purpose of the auxiliary burner is to provide a pilot flame for ignition of the biofuel and flame stability. During normal operation when the pilot is used for flame stability, it usually provides less than 10% of the total energy input. In some designs, the auxiliary burner is capable of providing all the heat input required to maintain operation during emergency conditions such as interruption in fuel feed and, thereby, avoid system shutdown. Typically, combustion of both the biofuel and auxiliary fuel are modulated automatically.

The hot gas produced with suspension burners can be used for direct heating applications such as dry kilns or veneer dryers, or used indirectly with the aid of heat exchangers. The gas contains all of the ash present in the fuel. In the case of indirect heating applications, suspension burners are frequently coupled to package boilers for producing steam, or the combustion gases are passed through heat exchangers for producing hot oil, hot water or hot air. In some cases, manufacturers supply the heat exchange unit as an integral part of the suspension burner system.

There are two main sub-types of suspension burners: pure suspension burners and cyclonic burners. In addition, manufacturers offer systems which are actually a combination of pure suspension burning and cyclonic burning.

Pure suspension burners are used to fire fine material (typically less than 2 mm) and dry (typically less than 15% moisture content) material in a stable flame formed by a burner register. The burner register is wall-mounted to fire directly into large chambers, usually fire-tube or water-tube package boilers. Auxiliary burners are usually required to provide flame stabilty and to provide from 2% to 10% of the rated capacity.

Pure suspension burners are particularly well suited to retrofitting existing boilers fueled with fossil fuels.

Cyclonic suspension burners can burn larger particles (up to 40 mm) than possible with pure suspension burners. These burners consist of a relatively large cylindrical combustion chamber into which fuel and air are introduced tangentially, often at several points along its longitudinal axis, which produces cyclonic circulation of gases. The combustion chamber is refractory lined and reradiates heat to provide flame stability. Therefore, auxiliary burners are provided only for startup or for emergency use. The long residence time of particles in the combustor which results from the cyclonic flow promotes complete combustion of the wood particles.

Cyclonic furnaces can be operated in two different temperature modes:

- slagging, in which the temperature is high enough to melt the ash;
- non-slagging, in which the temperature is 1,000 C or less and the ash does not melt.

Non-slagging operation is preferred to reduce refractory deterioration and facilitate ash removal. Severe refractory deterioration and difficulty of liquid ash removal has occured with slagging cyclonic burners. Problems with slagging are worst for dirty fuels because of the high inorganic contaminant.

Typically, all suspension burners require that the biomass fuels are relatively clean and dry with moisture contents below 20% and ash contents below 3%. Generally, cyclonic burners have less stringent fuel specifications than do pure suspension burners. Compared to other combustion systems, suspension burners can operate effectively over a wide range of load levels, with turndown ratios ranging from 3:1 to 5:1 for cyclonic burners and from 4:1 to 6:1 for pure suspension burners (5 to 10 seconds) than for cyclonic burners (58 seconds maximum).

Particulate emissions from suspension burners equal the fuel ash content when no gas cleanup equipment is used, so vary with the fuel ash content. Emissions are typically less than 0.25 g/m3 for low-ash fuels and with complete combustion. Few manufacturers include pollution control systems with their systems, since the combustion gases are usually directed into a secondary conversion system such as a boiler or heat exchanger. The flue gas is cleaned downstream of these units as needed.

In all cases, biofuel are fed to suspension burners by pneumatic feeders. The air stream carrying the fuel also acts as the primary combustion air. In the case of pure suspension burners, there is no secondary air source and combustion occurs with comparatively little excess air, viz, 15% to 40%. On the other hand, cyclonic burners generally are supplied with secondary combustion air, usually at several points, and these operate with as much as 250% excess air. Ash removal systems are not provided by manufacturers of pure suspension burners, as these rely on the accompanying package boiler system for this function. With cyclonic burners, provision is made for ash removal, although most often this consists of simple cleanout doors for manual cleaning.

Theoretically, a suspension burner can approximate 100% efficiency. Practically, heat can be lost in a number of ways:

- by heat loss through the combustion chamber walls;
- by unburned fuel leaving with ash or gases;
- by loss through ash which is removed hot.

In most cases, these will not exceed 5% of the input energy of the fuel.

Thus, suspension burners which produce a hot gas for subsequent use, in themselves, are probably more than 95% thermally efficient. In the extreme, a suspension burner firing into an existing boiler should have virtually no heat losses itself because the boiler becomes the combustion chamber. Some units are built with integral heat recovery systems which produce clean hot air, hot water, steam or oil, and their overall efficiency will be much less than 100%. These units are closer to boilers than pure suspension burners, but the primary combustion mode is by suspension burning.

3. Fluid Bed Combustors

Fluid bed combustors are a relatively new technology for combustion of biomass fuels. They involve burning fuel particles, which may have a wide range of sizes (up to 100 mm) and moisture contents (up to 65%), while in suspension in an air-dispersed (fluidized) bed of fuel and inert granular material (usually silica sand).

Combustion takes place with the fuels dispersed throughout the expanded bed of granular solids that is fluidized by a uniform upflow of air and combustion gases (Figure 4). The granular solid is used to provide both a heat reservoir and a turbulent mixing zone for combustion to take place.

Fluidization occurs when air is passed upwards through the bed of granular material. Initially, air simply percolates through the bed. As the air flow increases, the granular material is lifted, circulated within the bed, and the entire mass takes on a boiling appearance because of the flow of gas bubbles. This boiling or fluidization persists over a fairly wide range of air flow rates.

Inlet air for combustion is distributed below the fuel bed using either nozzles, a perforated plate, or some similar distributor. The vigorous bubbling and mixing action of the fluid bed promotes good dispersion of fuel throughout the bed and uniformity of bed temperature. The bed is usually abrasion-resistant and thermally-stable sand, with a particular size distribution conducive to good fluidization. The depth of the sand bed varies with the manufacturer of the system and affects the proportion of combustion occuring in the bed and in the freeboard region. A freeboard region is needed to allow

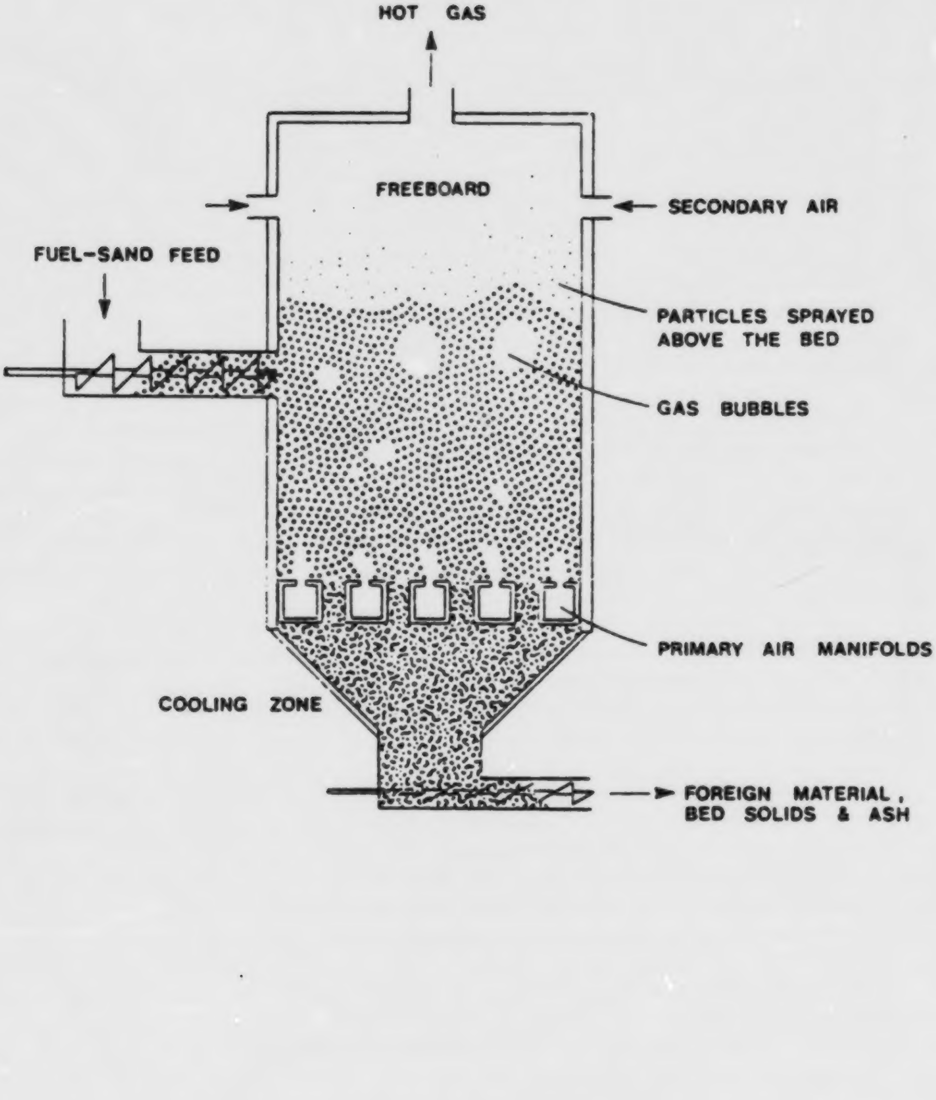
HOT GAS
FREEBOARD
SECONDARY AIR
FUEL-SAND FEED
PARTICLES SPRAYED ABOVE THE BED
GAS BUBBLES
PRIMARY AIR MANIFOLDS
COOLING ZONE
FOREIGN MATERIAL, BED SOLIDS & ASH

FIGURE 4 FLUID BED COMBUSTOR

heavier particles that may otherwise be carried out of the bed to disengage from the gas flow and fall back to the bed.

There are wide variations in design concepts of fluid bed combustion systems. These variations in design basically affect the amount of combustion that occurs in the fluid bed and the amount that occurs in the freeboard above the bed. In true fluid bed or deep-bed combstors, combustion of all the fixed carbon and most of the volatiles occurs in the bed. The bed tends to be fairly deep and, consequently, the pressure at the bottom of the bed is high. Bed temperatures are usually higher than or equal to the freeboard temperatures.

Fluid grate or shallow-bed combustors have shallow beds in which only the largest particles are burned in the bed itself. Small particles and the released volatiles burn in the freeboard region producing higher temperatures than in the bed. Because of the relative shallowness of the bed, lower pressures are encountered at the bottom of the bed compared to that for deep fluid beds.

A third design variation is the recirculating fluid bed. In this design, fluidizing air velocities are very high, entraining large particles which burn in transit. The bed and fuel particles carried overhead are separated from the flue gas and recirculated until complete combustion of the fuel is achieved.

Recirculating fluid beds have high volumetric heat release rates similar to conventional fluid beds because of the high gas velocities that are used and the presence of the hot bed solids in the gas. Advantages of this design include a higher turndown ratio than fluid beds because the minimum output is not limited by bed defluidization, fuel input is simplified since it does not have to be distributed in a fluid bed, and a lower inlet air pressure may be used. Disadvantages of the design include the requirement for an efficient refractory-lined cyclone to separate bed solids and fuel particles from the hot gas stream for recirculation, and the need for a tall combustor to allow a reasonable gas residence time for combustion.

The intense mixing within fluid beds makes them capable of high volumetric heat release rates and results in high heat transfer coefficients for immersed heat transfer surfaces. These two characteristics of fluid bed combustors make it possible for units to be more compact than comparably-sized units using any other combustor design. Turndown ratios of commercial units using a single fluid bed are limited to about 2:1 to 3:1 by the fluidization characteristics of the bed material; lower output rate being limited by defluidization of the bed, and upper output rate by carryover and heat release rate. Higher turndown ratios may be achieved by using "multiple" beds formed by physically segregating parts of the bed or by zonal control of air flow through the distributor. These parts of the bedmay be fluidized as required to achieve a desired output level.

Feeding of fluid bed combustors is done with either a feed chute or a pneumatic feeder above the bed, or a screw feeder within the bed. Over-bed feeding has a tendency to worsen carryover of fine, unburned fuel. For these designs, the freeboard must be sized to allow a residence time sufficient for near-complete combustion of fine particles.

There should be provision for removal of foreign material and the bed material from the bottom of the combustor. This material may be screened to separate ash and foreign materials from the bed solids, which may then be recycled. Much of the ash from the fuel is discharged with the combustion gases and must be captured by the cyclones or other emission control devices. Since combustible solids will be present in ash carried over with the flue gas and discharged with any bed material, a higher combustion efficiency may be obtained by reinjection of the ash to the combustor. This mode of operation will increase the particulate loading in the flue gas and, therefore, make the selection of pollution control devices more critical.

The efficiency of conversion of fuel heating value to hot gas varies considerably. Most units draw off sand continuously to remove ash and other inert materials (rocks, scrap metal). This bleed stream represents a significant heat loss in addition to the normal unburned fuel losses and heat loss from the equipment. Some units have tubes installed in the sand below the air injection system to cool the sand and recuperate heat. These are most common when the unit is used with a waste-heat boiler, and heating of boiler feedwater is desirable.

Typically, thermal efficiencies should exceed 90%.

Fluid bed combustors are proven technology available as individual units for generation of hot gas or coupled to a water-tube or fire-tube boiler for steam generation. Most fluid bed combustors are used for heating, drying, and firing of water-tube and fire-tube boilers.

4. Integral Systems ("Boilers")

The systems which combine a combustion chamber or firebox with an intregal heat exchanger can be classified by the combustor configuration (suspension, fluid-bed, single or multiple chamber), by the secondary heat transfer media employed (air, water, oil, steam) or even by the configuration of the heat exchanger (fire-tube, water-tube). In general, there are three broad categories: furnaces, with air as the heat transfer medium; boilers, with steam or water; and thermal-oil heaters with oil as the heat transfer medium.

Furnaces

Normally in the smaller size range (up to about GJ/h) the main function of furnaces is space heating of warehouses, garages, small industrial shops, farm buildings or commercial establishments. They are also used to supply process heat in applications which require a clean hot air flow, such as the drying of agricultural products.

Firebox design is typically single or multiple chamber with fuel combustion either pile-burning on a fixed grate or semi-suspension burning when dry particulate fuels are used. Furnaces are factory assembled and shipped as packaged units for installation with minimal assembly. Systems for particulate fuels usually include a fuel storage bin and metering system aspart of the furnace package.

Boilers

While technically only steam generating units are boilers, the term is used for intregal systems using steam or hot water as the heat transfer media. Boilers are either field erected or shop-assembled, ready to place on prepared foundations. A field-erected boiler is usually too large to be assembled at the factory and moved to the site as a single unit; they generally have a capacity greater than about 65 GJ/h, well beyond the maximum size considered in this catalogue.

A factory-assembled unit is commonly called a package boiler and is shipped on skids ready to connect and operate. The capacity, pressure, and temperature of these units are lower than those of the large field-erected boilers, but they have considerably lower installed costs per unit of energy output.

Package boilers are divided into two main classes: fire-tube or water-tube, the basic difference being the relative position of the hot combustion gases and the water.

In a fire-tube boiler the combustion gases pass inside the boiler tubes which are inside a water-filled shell where the steam is generated. Combustion can be external to the boiler shell or within a large internal tube. Hot gases make one, or several passes through the fire-tubes before exiting to the stack through the gas cleaning equipment.

Water-tube boilers employ a large number of comparatively small tubes through which water circulates between a steam drum and a mud drum. The combustion gases are on the outside of these tubes. Combustion can be external to the tube bank or located within a chamber formed by tube walls.

Steam generated in a water-tube boiler can be of higher pressure than that of a fire-tube boiler because the steam is within the small diameter tubes rather than in a large diameter boiler shell which cannot withstand as high pressure. Generally fire-tube boilers are of less than 1.6 Pa and water-tube boilers of greater pressure.

Fire-Tube Boilers:

Package boiler systems which require a low to moderate steam capacity and pressure output are usually of fire-tube design. There are several possible arrangements of fire-tubes, such as vertical, horizontal and inclined. The most popular of these is the horizontal arrangement (Figure 5). The main advantage is that it is easily accesible for inspection and cleaning. The tube arrangement can be further divided into single pass and multiple pass contruction.

Single pass is the simplest contruction. Combustion gases travel through the furnace to the rear of the boiler in one pass. This type of construction is usually used for small capacity units. Horizontal Return Tube (HRT) boilers have a two-pass arrangement as shown in Figure 5. The first pass is along the bottom half of the shell toward the rear wall of the setting. The gases then reverse to make a seocnd pass through the fire tubes to the chimney at the front of the boiler.

In order to increase the effective heat transfer surface area per unit volume, most package boilers provide more than a single pass through the tubes. The combustion gases are routed back and forth by means of baffles. Fire-tube package boilers may have as many as four passes. This type of construction is used to provide relatively larger capacity and still maintain a fairly compact body.

In order to obtain heat from the heating surfaces there must be an adequate and positive circulation of water around the tubes of a fire-tube boiler. This circulation of water usually takes place by natural means. When water in the vessel is heated, it expands and becomes less dense. This causes it to rise upwards towards the top of the vessel with cooler and denser water descending to take its place. As the water begins to boil, the circulation will become more positive because the rising portion of water is now a mixture of water and steam bubbles, and the circulation will become more vigorous.

Water-Tube Boilers

There are several basic designs of water-tube package boilers. The most common is the D design with one upper steam

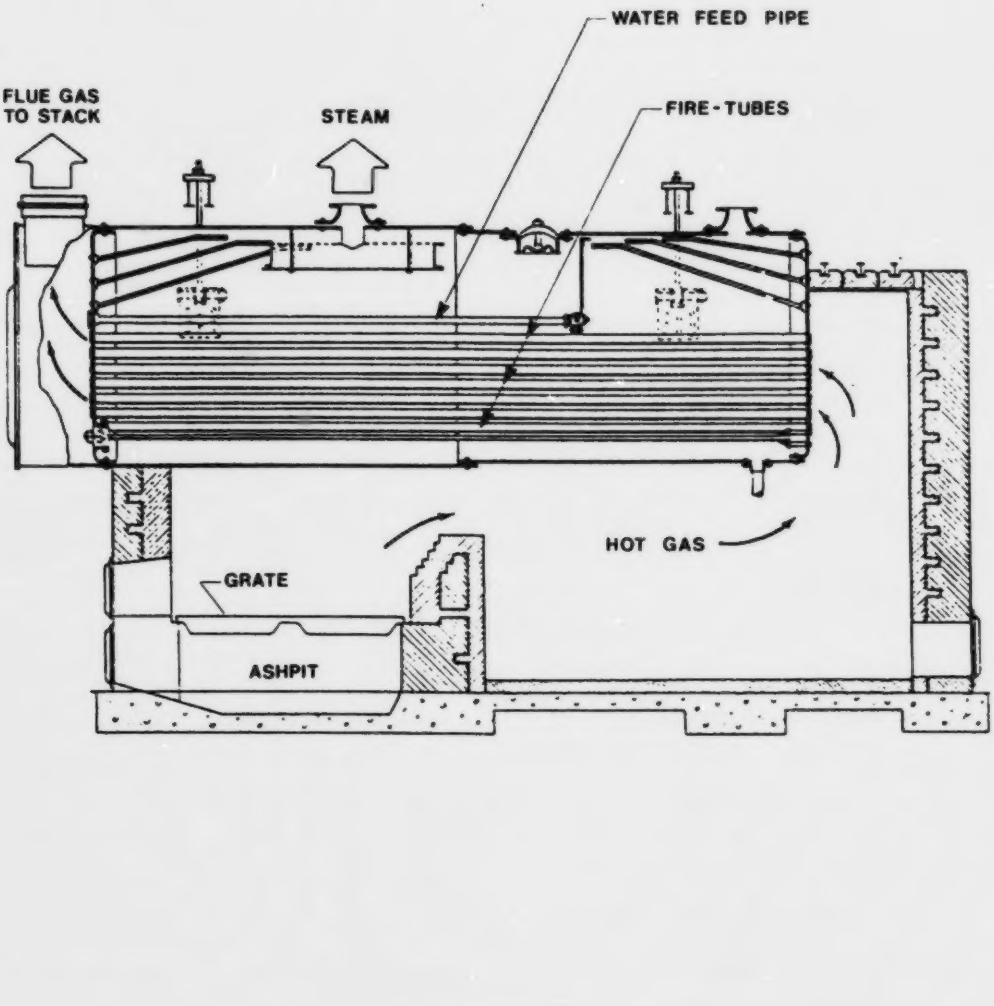
WATER FEED PIPE
FLUE GAS TO STACK
STEAM
FIRE-TUBES
HOT GAS
GRATE
ASHPIT

FIGURE 5 FIRE-TUBE BOILER

drum directly over the lower mud drum. While some boilers use pumps to provide forced circulation, most smaller designs rely on natural circulation. Denser water in the downcomers, located in the cooler regions of the furnace displaces the lighter water-steam mixture within the risers located in the hottest zones of the furnace.

Single or Multiple Combustion Chamber Boilers

Typical package boilers utilize single or multiple combustion chambers known as fireboxes in which hot gases are generated by direct combustion (Figures 6 and 7). The hot gases are then induced into a fire-tube boiler or a water-tube boiler designed to recover heat from the combustion gases and produce steam. Flue gases usually pass through an air preheater and mechanical dust collector before exiting to the stack via the induced draft fan.

A metered amount of fuel is delivered onto the furnace grate where fuel gasification and carbon combustion occur. Preheated primary air is introduced under the grate and overfire air is introduced above the fuel pile. Combustion is sustained and completed inside the fire-box. Ash and non-combustible matter are removed periodically from drop-out chambers or ash pits.

Flyash is usually collected in a single stage multi-clone mechanical dust collector. Dust collected at the mechanical dust collectors often contains unburned carbon particles. These can be separated from the fine flyash by mechanical classification and reinjected into the furnace.

While most package boilers operate automatically, continuous supervision by licensed operators may be required by provincial regulations.

Suspension Burner Boiler

The combustion component of these systems is basically a suspension burner firing biofuels over a grate.

As the burner is designed to fire in suspension, it will accept only dry, sized fuel. When mixed with finer fuel material, the fuel particle size can be up to 6 mm square by 25 mm. A moisture content of 15% to 20% is considered maximum.

Dry, sized, biomass fuel is dropped through the fuel inlet of the boiler into the furnace where it is burned, partially in suspension and partially on a grate.

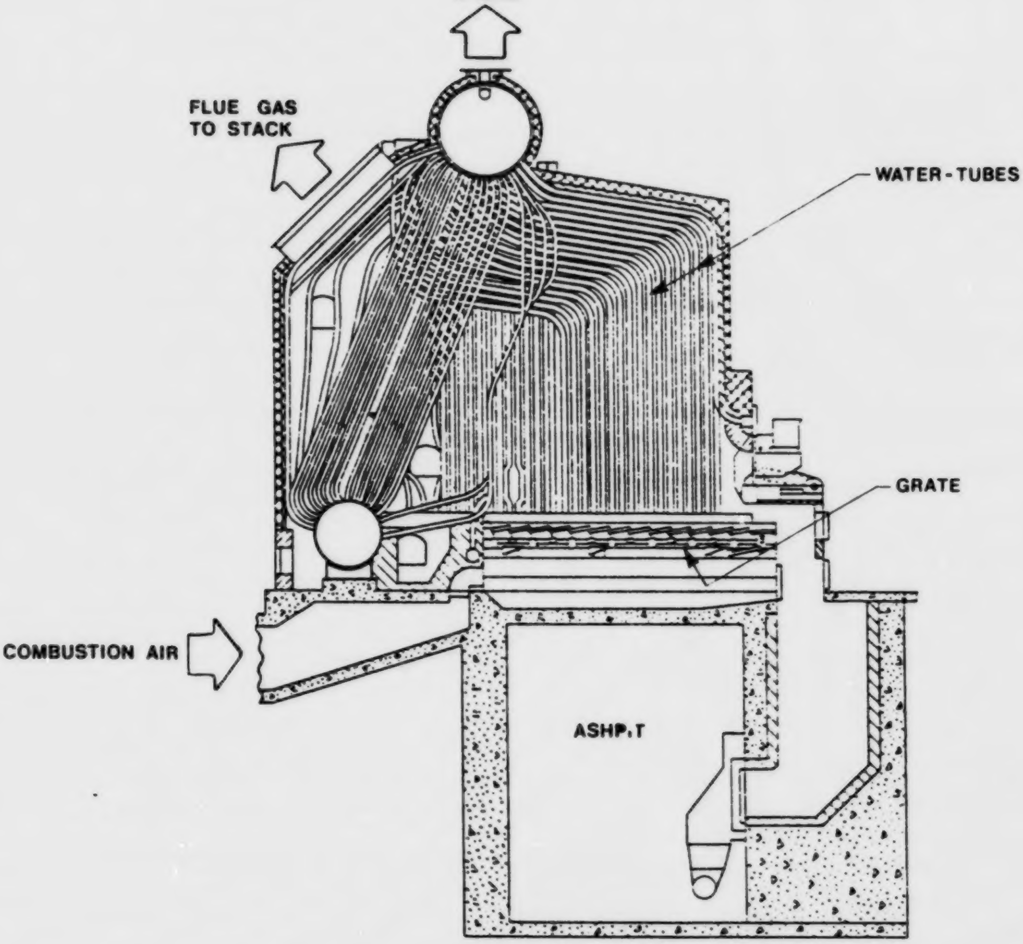
STEAM
FLUE GAS TO STACK
WATER-TUBES
GRATE
COMBUSTION AIR
ASHPIT

FIGURE 6 SINGLE CHAMBER WATER-TUBE BOILER

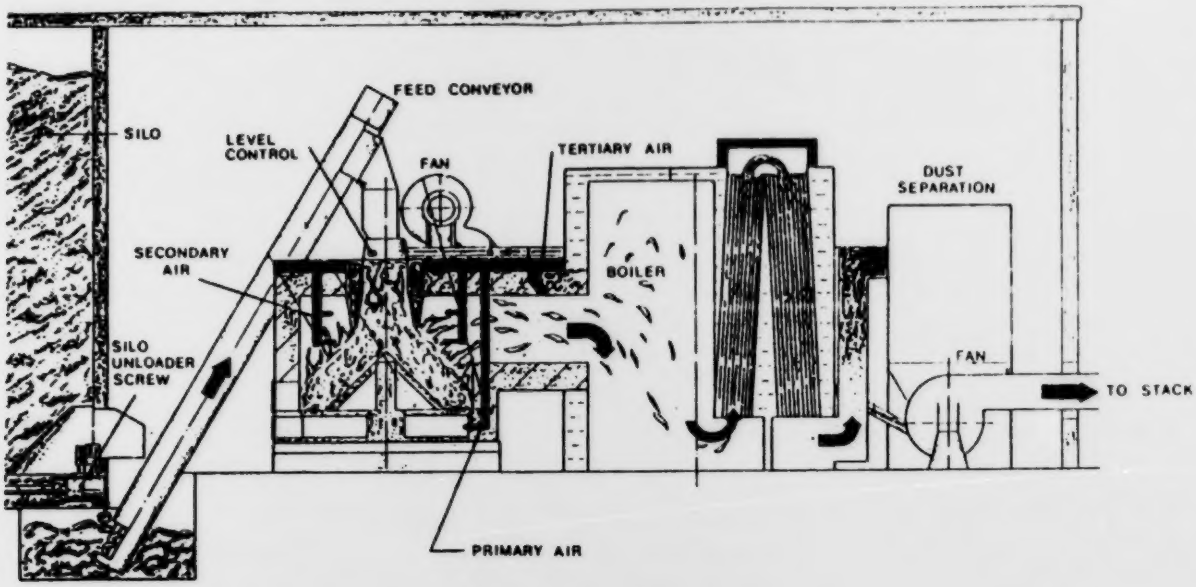
FEED CONVEYOR
SILO
LEVEL CONTROL
FAN
TERTIARY AIR
DUST SEPARATION
SECONDARY AIR
BOILER
SILO UNLOADER SCREW
FAN
TO STACK
PRIMARY AIR

FIGURE 7 MULTIPLE CHAMBER BOILER

The boiler is usually of a multi-pass fire-tube design. The boiler efficiency is expected to be high due to the low moisture content in the fuel requirements.

A single stage multi-clone mechanical dust collector is normally used to catch the flyash and unburned particles. Dust collected by the mechanical dust collectors is usually reinjected back to the furnace without classification.

Fluid-Bed Boilers

Package boilers are also available utilizing fluid-bed combustors (Figure 8). The fluid-bed combustor consists basically of a bed of sand. A sufficient volume of hot air (preheated by exhaust gases and/or auxiliary burner) is passed up through the bed causing the sand to unlock, boil and mix. The sand never actually reaches a liquid state but it is hot enough to ignite the biomass fuel.

Biomass fuel is normally limited to below 75 mm in size and less than 55% to 60% moisture content wet basis. Fuel is fed from a metering bin by an underfeed stoker which injects the fuel to the top of the fluid bed burner.

Two combustion processes usually take place here. Large particles achieve combustion on the bed and smaller particles burn in suspension in the vapour space above the bed.

Ash and non-combustible matter, generally finer and heavier than biomass fuel, tend to separate and eventually move downwards until they reach the bottom. Ash and non-combustible matter can then be removed periodically or continuously by a screw feeder or other device.

Flyash is normally collected in a single stage multi-clone mechanical dust collector, and larger unburned carbon particles can be separated and reinjected into the furnace.

While some system designs have used water-tube boilers, a conventional multipass fire-tube unit is usually used to suit the fluid bed design. Multiple package systems can be utilized to meet greater steam demand requirements.

Some advantages of fluid-bed combustors include:

- sand, dirt and other impurities need not be removed from the fuel, they will be separated in the bed;

- high moisture content woodwaste fuel (up to 60% wet basis) combusts readily in the fluid bed.

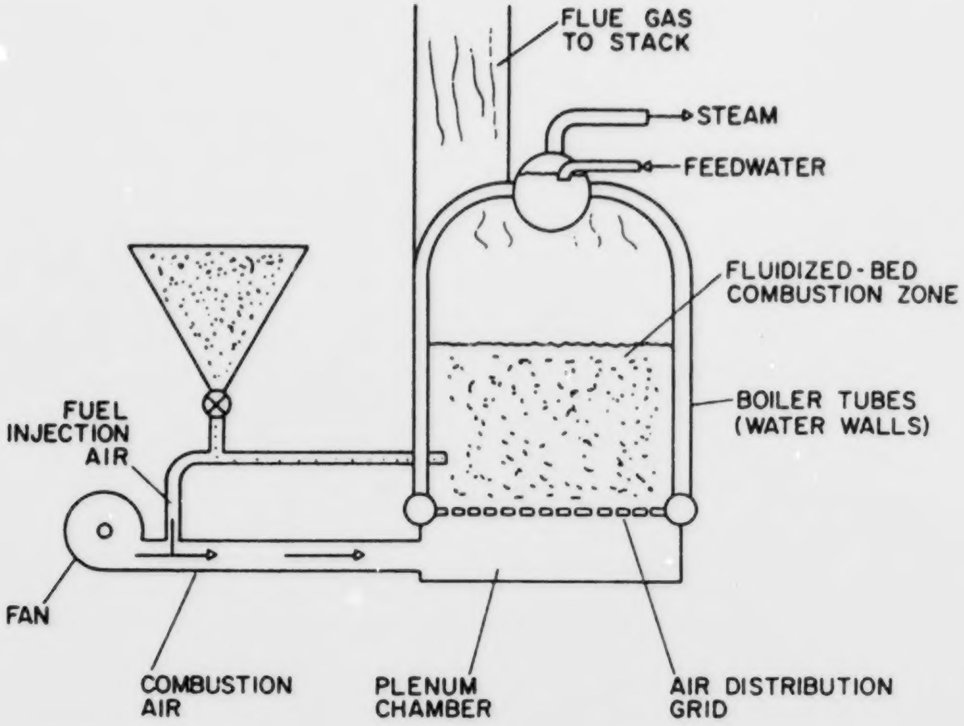
FLUE GAS TO STACK
STEAM
FEEDWATER
FLUIDIZED-BED COMBUSTION ZONE
BOILER TUBES (WATER WALLS)
FUEL INJECTION AIR
FAN
COMBUSTION AIR
PLENUM CHAMBER
AIR DISTRIBUTION GRID

FIGURE 8 FLUID BED WATER-TUBE BOILER

III. DIRECTORY GUIDE

A. General Organization

This section is divided into two parts. The first part, Section B, deals with the systems data base and the second part, Section C, deals with the consultants' data base.

Previous catalogues of biomass combustion systems have generally been presented in a format organized by generic system type, i.e. combustors, suspension burners, integral boiler systems, etc. While this provides a logical presentation of equipment, it is sometimes awkward for the user to adequately match their resources and needs to this format. In addition, several system designs allow for flexible firing arrangements making a definitive classification sometimes misleading. Therefore, a different format has been adopted to better facilitate the user's selection criteria and provide easy access to system data.

Typically, a potential bioenergy user has access to a specific fuel type and has an application which requires a certain energy form, i.e. hot gas, steam, hot water or hot oil. An equipment reference guide has been provided (Table III-1) which lists suppliers by fuel suitability of their systems and available energy output form. Once systems have been identified as being suitable for a particular fuel and energy form, detailed data can be obtained from the directory of alphabetically listed suppliers (Section B). In addition, available ranges of outputs and the generic equipment classification for each system is provided in the reference guide.

Systems presented in Table III-1 are listed first by fuel suitability and second by energy output. Fuels have been classified into three categories - forest-based fuels, municipal/industrial solid waste and agricultural wastes. Because of the diversity of the forest-based biofuels, these fuels have been further categorized into whole log, hog fuel, wood chips and sawdust classifications. Systems are listed in order of their suitability to the fuels as mentioned above. Typically, suppliers of biofuel energy recovery equipment have indicated system versatility in handling various fuels. Systems offering multiple fuel use capability are listed in the same order described above but with the most versatile systems listed first. In addition, secondary fuel indicators have been applied to fuels claimed by suppliers to be suitable for firing by their systems but which have not been demonstrated.

Generally, the capability of systems to handle various fuels is dependent on system design criteria for specific fuel sizes and moisture contents. Several systems require pretreatment of some fuel types to meet these design criteria. This pretreatment may include size reduction or fuel drying. Characteristics of the available fuel should be well defined prior to contacting suppliers for further information regarding the

TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
TSI Trintek Systems Inc.	Basic	Multiple chamber combustor	0.4 - 5.9	*	*	*	*	*	*	*	*	*	*
Boilersmith Ltd.	Victor, Syncro, Tempest	Integral boiler Multiple chamber combustor	0.2 - 50 0.2 - 0.5	*	*	*	*	*	*	*		*	
Les Industries Franks Piping Inc.	ES	Integral boiler	0.5 - 32	*	*	*	*	*	*	*		*	
Westinghouse Canada Ltd.	Westinghouse - O'Connor	Integral boiler	21 - 190	*	*	*	*	*	*	*			
Olivine Corporation	Olivine	Single chamber combustor	0.2 - 21	*	*	*	*	*	*				*
Interfor Consultants Ltd.	Saxlund	Single chamber combustor	1 - 20	*	*	*	*			*	*	*	*
New Yorker Boiler Co., Ltd.	New Yorker	Integral boiler	0.2 - 35	*	*	*	*			*		*	
Canaburn Bioenergy Inc.	Laka	Multiple chamber combustor	0.1 - 7.3	*	*	*	*					*	

- continued -

TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
Lamb-Cargate Industries Ltd.	Lamb Wet-Cell	Multiple chamber combustor	10 - 75	*	*	*	*						*
Shafter Brothers Inc.	Viking	Integral boilers	0.4 - 1.3	*		*	*			*		*	
EXO Technologies Ltd.	EXO Combustors	Single chamber combustor	N/A	*		*		*					*
Parrsboro Metal Fabricators Ltd.	Kerr	Integral boilers	0.1 - 0.7	*								*	
Aqua-Therm	Aqua-Therm	Single chamber combustor	0.15 - 0.37	*								*	
W.R. Benjamin Products Ltd.	Benjamin	Integral boilers	0.1 - 0.5	*								*	
Corrigan's Welding & Wood Stove Centre	Patlyn	Single chamber combustor	0.2 - 0.7	*								*	
Trent Industries Inc.	Trent	Multiple chamber combustor	2.1 - 36		*	*	*		*	*	*	*	*
Salton	Wellons Cyclo-Blast	Multiple chamber combustor	5 - 250		*	*	*		*	*	*	*	*

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TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
Dorr-Oliver Canada Ltd.	Fluosolids Combustion System	Fluid bed	2.1 - 527		*	*	*		*	*	*	*	*
Thomas Industrial Sales Ltd.	Volcano	Integral boiler	7 - 100		*	*	*	*	*	*	*	*	
Volcano	Volcano	Integral boiler	7 - 100		*	*	*	*	*	*	*	*	
Argusfyr Inc.	Argusfyr	Integral boiler	0.4 - 21		*	*	*		*	*	*	*	
Peabody Engineering Canada	Peabody	Suspension burner	3.7 - 316.5		*	*	*		*		*	*	*
Konus Energy Systems Ltd.	Konus	Multiple chamber	2 - 40		*	*	*		*	•	*	•	
Energy Systems KMW Inc.	KMW	Single chamber combustor	1 - 52.5		*	*	*			*	*	*	*
Solid Energy Systems Ltd.	KMW	Single chamber combustor	1 - 52.5		*	*	*			*	*	*	*
Donlee Technologies Inc.	York-Shipley	Fluid bed combustor	7.5 - 120		*	*	*			*		*	*
Kerr Controls Ltd.	Kerr	Single chamber combustor	0.1 - .4		*	*	*			*		*	*

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TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
Bigelow-Liptak of Canada Ltd.	ERS	Integral boiler	0.3 - 21		*	*	*			*	*	*	
Jellicoe Resource Associates	Biomass Thermal Utilities	Integral boiler	0.3 - 16		*	*	*			*		*	
J.M. Schermerhorn	Cleaver-Brooks	Integral boiler retrofit	4 - 28		*	*	*			*		*	
Scotia Farm Services Ltd.	Dumont	Integral boilers	0.1 - 7		*	*	*			*		*	
Lambton Conveyor/Stoimor	Lambton	Single chamber combustor	3.2			*	*		*				*
Hakmet	Swebo	Integral boiler retrofit	0.4 - 1.8			*	*		*			*	*
	TP 2000	Integral boiler retrofit	0.1 - 1.8			*	*		*			*	*
Canaburn	Sasmo	Integral boiler retrofit	0.3 - 2.6			*	*			*		*	
Grovewood Heat Inc.	Woodshed	Furnace retrofit	0.2 - 1.0			*	*					*	*

- continued -

TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
Tilley Manufacturing Ltd.	Tilley	Integral boiler	0.3 - 0.7			*	*						*
Waycot Systems Ltd.	Waycot	Multiple chamber combustor	21 - 120			*	*	•	•				*
Maco Enterprises	Maco	Integral boiler retrofit	0.3 - 8			*				*		*	
BDR Machinery	Vallsta Iwabo	Combustor retrofit	0.1 - 1.5			*							*
Coe Manufacturing	Energex	Suspension burner	16 - 47				*						*
Coen Burners Canada Ltd.	DAZ	Suspension burner	5.3 - 158				*						*
Bio-Char Inc.	Bio-Char	Multiple chamber combustor	5 - 58	•	•	•	•	*	•	*	*	*	*
Superburn Systems Ltd.	Superburn	Fluid bed combustor	3.2 - 27	•	•	•	•	*	•	*	*	*	
Envirowest Industries Ltd.	Envirowest Incinerator System	Multiple chamber	1.7 - 21	•	•	•	•	*	•	*		*	*

- continued -

TABLE III-1 SYSTEM SELECTION REFERENCE GUIDE

COMPANY	SYSTEM/MODEL NAME	SYSTEM GENERIC TYPE	AVAILABLE OUTPUT SIZE RANGE (GJ/h)	FUEL SUITABILITY						ENERGY FORM			
				WHOLE LOGS	HOG FUEL	WOOD CHIPS	SAWDUST	MUNIC/ IND. WASTE	AGRICULT WASTE	STEAM	HOT OIL	HOT WATER	HOT GAS
Pyrothermtec Contracting Ltd.	Thermtec	Multiple chamber combustor	1.6 - 16	•	•	•	•	*	•	*		*	*
Thermaco Engineering Services Ltd.	Pyrotek	Multiple chamber	0.5 - 18					*	•	*	*	*	*
Tricil Ltd.	Consumat	Multiple chamber combustor	0.2 - 48					*		*	*	*	*
The Enercan Group	Enerkiln Staged Combustion System	Multiple chamber combustor	10 - 50					*		*			
Sukup	Biomaster Furnace	Single chamber combustor	1.6 - 3.6			•	•		*				*

suitability of individual systems to specific applications. Typical fuel size distributions and moisture contents of the fuel classifications are presented in Table III-2. For applications involving biofuels not listed or mixtures of various fuels, potential systems can be identified by matching available fuel quality with the characteristics listed in Table III-2.

Several system designs are provided with flexible arrangements to allow various energy forms to be produced. These have been indicated in Table III-1 the same as fuel suitability and are listed in decreasing order of sophistication. The simplest system will produce hot gas consisting of combustion products. In most cases these systems can be coupled with additional energy conversion equipment (e.g. waste heat boilers and heat exchangers) to upgrade the energy form. Where hot gas is to be used in a direct application, consideration should be given to the available gas cleanup system since the product may have a relatively high particulate concentration.

The consultant's data base contains a listing of all consultants in alphabetical order in Table III-4. A detailed listing by province in alphabetical order forms the bulk of Section C.

B. System Data Base

The system directory presented here provides a data base of information for suppliers responding to questionnaires distributed to various manufacturers (Appendix I). The list of manufacturers/suppliers contacted for information was prepared based on information provided by various provincial and federal government departments (Energy & Resources, Agriculture, Trade & Commerce, Regional Economic Development), trade directories and in-house information available to the authors. Emphasis was placed on domestic manufacturers and foreign suppliers having representatives in Canada. In addition, some foreign suppliers offering unique system designs or having significant experience in servicing the Canadian market have been included.

The information provided in the system directory is a direct transposition of supplier responses to questionnaires. No attempt has been made to assess the validity of system design or verify supplier's claims to system performance. A system description is provided in the directory based on technical brochures and data submitted by the suppliers with the completed questionnaires.

System specifications provided by the respondents are presented in the directory and include fuel suitability parameters, auxiliary fuel and electrical requirements, available range of output, energy form and range of fuel input (mass per unit time). This section is designed to provide the user with a more detailed assessment of system applicability once appropriate systems have been identified within the reference guide

TABLE III-2 TYPICAL SIZE DISTRIBUTION AND MOISTURE CONTENT OF MAJOR BIOFUELS

	SIZE RANGE (mm)	MOISTURE CONTENT (% wb)
Wood		
hog fuel	2 - 100	40 - 60
sander dust	< 1	2 - 8
sawdust	1 - 10	25 - 40
chips	13 - 50	25 - 60
whole logs (seasoned)	> 150	25 - 50
Municipal/Industrial Wastes	10 - 300	10 - 85
Agricultural Wastes	1 - 100	15 - 50

(Table III-1). In some cases, suppliers have not provided all data required in this section. It is advised that where doubt exists as to the compatibility of fuel and/or application to a specific system that suppliers be contacted for further information.

A brief description of standard and optional ancillary equipment is included in the directory which covers fuel handling, pollution abatement, ash handling and instrumentation. In general, standard control systems and ash handling arrangements are provided within the combustion equipment design. Conversely, facilities for fuel handling (with possibly the exception of system feed) and pollution abatement are rarely standard and flexible arrangements are provided. These equipment requirements will depend on fuel characteristics, local emissions standards and system application.

Approximate system costs were requested from suppliers to cover the range of system sizes available. Two costing approaches are provided for the systems. The first consists of the basic combustion equipment and only includes the minimum ancillary equipment necessary (e.g. feed system, basic controls, etc.). This cost might be applicable to retrofits on existing plants or where simple stand-alone systems are required. The second costing approach is for turnkey systems which would include the total equipment requirements for fuel and ash handling, emission controls, foundations, etc. This cost might be applicable to large systems and new facilities.

INDEX OF SYSTEM SUPPLIERS

COMPANY	SYSTEM NAME	PAGE
AQUA-THERM	Aqua-Therm	37
ARGUSFYR INC.	Argusfyr	39
BDR MACHINERY LTD. (Vallsta, Iwabo)	Vallsta, Iwabo	42
W.R. BENJAMIN PRODUCTS LTD.	Benjamin	44
BIGELOW-LIPTAK OF CANADA LTD.	ERS	46
BIO-CHAR INC.	Bio-Char	48
BOILERSMITH LTD.	Victor, Syncro, Tempest	50
CANABURN BIOENERGY INC.	Laka	53
CANABURN BIOENERGY INC.	Sasmo	56
COE MANUFACTURING	Energex	59
COEN BURNERS CANADA INC.	DAZ	61
CORRIGAN'S WELDING & WOOD STOVE CENTRE	Patlyn	64
DONLEE TECHNOLOGIES INC.	York-Shipley	66
DORR-OLIVER CANADA LIMITED	Fluosolids Combustion System	69
THE ENERCAN GROUP	Enerkiln Staged Combustion System	72
ENERGY SYSTEMS KMW INC.	KMW	74
ENVIROWEST INDUSTRIES LTD.	Envirowest Incinerator System	78
EXO TECHNOLOGIES LTD.	EXO Combustors	81
GROVEWOOD HEAT INC.	Woodshed	83
HAKMET LTD.	Swebo	85
HAKMET LTD.	TP 2000	87

INDEX OF SYSTEM SUPPLIERS (CONTINUED)

COMPANY	SYSTEM NAME	PAGE
INTERFOR CONSULTANTS LTD.	Saxlund	89
JELLICOE RESOURCE ASSOCIATES	Biomass-Thermal Utilities	91
KERR CONTROLS LIMITED	Kerr	94
KONUS ENERGY SYSTEMS LTD.	Konus	96
LAMB CARGATE INDUSTRIES	Lamb Wet-Cell	99
LAMBTON CONVEYOR/STORMOR	Lambton	101
LES INDUSTRIES F.P. INC.	ES	104
MACO ENTERPRISES	Maco	107
NEW YORKER BOILER CO., LTD.	New Yorker	109
OLIVINE CORPORATION	Olivine	111
PARRSBORO METAL FABRICATORS LIMITED	Kerr	113
PEABODY ENGINEERING CANADA	Peabody	115
PYRO THERMTEC CONTRACTING LTD.	Thermtec	118
SALTON FABRICATION LTD.	Wellons Cyclo-Blast	120
J.M. SCHERMERHORN	Cleaver-Brooks	123
SCOTIA FARM SERVICES LTD.	Dumont	126
SHAFTER BROS. INC.	Viking	128
SOLID ENERGY SYSTEMS LTD.	KMW	130
SUKUP MANUFACTURING CO.	Biomaster Furnace	133
SUPERBURN SYSTEMS LTD.	Superburn	135
THERMACO ENGINEERING SERVICES LTD.	Pyrotek	138
THOMAS INDUSTRIAL SALES LTD.	Volcano	141

INDEX OF SYSTEM SUPPLIERS (CONTINUED)

COMPANY	SYSTEM NAME	PAGE
TILLEY MFG LTD.	Tilley	144
TRENT INDUSTRIES INC.	Trent	146
TRICIL LIMITED	Consumat	149
TSI TRINTEK SYSTEMS (ONTARIO) INC.	Basic	152
VOLCANO INC.	Volcano	155
WAYCOT SYSTEMS LTD.	Waycot	158
WESTINGHOUSE CANADA INC.	Westinghouse-O'Connor	160

AQUA-THERM

ADDRESS	Box 281 Brooten, Minnesota 56316
PHONE	612-346-2264
TELEX	
FAX	
CONTACT	Mr. Olav Isane, Sales Manager
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	Sedor Stove Co. Box 479 Silvan Lake, Alberta
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Aqua-Therm manufactures whole log furnaces suitable for residential and small commercial heating applications. The combustion system is available in three sizes - 0.15, 0.30 and 0.37 GJ/h output. The system design is simple and straightforward consisting of a small combustion chamber capable of accepting logs in excess of 1 metre long. An internal heat exchanger is integrated into the stove design to provide hot water for direct convection heating applications or used for an existing forced-air furnace retrofit.

By virtue of the Aqua-Therm furnace design and simplicity, minimal auxiliary equipment is provided with the system. Fuel feed and ash removal is performed manually and simple control systems are provided to control combustion air, furnace fan interlock and water temperature.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- small log	
	Size	- minimum	8 cm
		- maximum	1.3 m
		- recommended	

Moisture - maximum 50%
- recommended

Auxiliary Fuel:

Electricity Requirements: 110 V - Draft fan and circulating pump

Output Capacity: 0.15 - 0.37 GJ/h

Energy Product: Hot water

Fuel Input Rate:

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: None

Emission Control: None

Ash Handling: Dry manual removal

Control Instrumentation: Thermostat fan control

D. SYSTEM COST

Basic Combustion - Smallest $ 2K
- Largest $ 2.5K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

List not provided

ARGUSFYR INC.

ADDRESS:	20 Huntingwood Cres. P.O. Box 2062 Bramalea, Ontario L6S 1S6
PHONE:	416-458-1667
TELEX:	06-218632
FAX:	
CONTACT:	Mr. S. (Sylvester) Ogunji, President
ACTIVITY:	Suppliers of complete Wood Waste Energy Systems
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	ARGUSFYR ENERGITEKNIK A/S Vibeholmsvej 16 Denmark-2605 Brondby

A. SYSTEM DESCRIPTION

ARGUSFYR is the supplier of fully automatic stokers which can be retrofitted into existing boilers or supplied as part of a complete turnkey combustion system. The size range covers units from small industrial to medium industrial applications (0.4 - 21 GJ/h). The combustion section is primarily a grate (part of the stoker) made of cast iron, on which the fuel sits during the combustion. The complete boiler normally has a rectangular combustion chamber with an open bottom, so that the stoker can be positioned underneath the boiler. The primary combustion air is blown into the chamber through the grate, while the secondary air enters through steel tubes located above the grate. The secondary air helps to ensure complete combustion of the fuel and facilitates maximum usage of the calorific value of the fuel, with minimum emission of unburned particles. A wide variety of biomass fuels can be utilized, including almost any kind of wood waste and a large number of different agricultural plant and animal waste materials. In addition to biomass fuels, coal, coke, and lignite can be processed.

The boiler is stoked using an auger conveyor system which is connected to the silo. The combustion and conveyor sections are controlled automatically by the boiler thermostat and pressurestat, while the silo unloading unit is controlled by a level control built into the conveyor section. In larger units, special de-ashing augers are fitted into the combustion chamber. These augers will automatically and constantly remove the ashes from the chamber.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, paper waste, coconut fibre, bioshell pellets, corn husks, and coal	
	Size	- minimum	granular
		- maximum	5.08 x 5.08 x 5.08 cm
		- recommended	1.27 x 1.27 x 2.54 cm
	Moisture	- maximum	50 - 60%
		- recommended	40 -50%
Auxiliary Fuel:		Gas, propane or oil	
Electricity Requirements:		220, 380, 600 VAC/60 Hz/three phase	
Output Capacity:		Sizes available - 0.422 - 21 GJ/h	
Energy Product:		Hot water, hot oil, steam	
Fuel Input Rate:		30.4 kg/h - 1.5 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Fuel storage can be in a round, square, or rectangular - steel or concrete container (inground or above ground). Fuel handling - flat bottom unloader, conic bottom unloader and hydraulic push rod system.
Emission Control:	Dry single cyclone, multi-cyclone or wet scrubber.
Ash Handling:	Could be manual or automatic, using conveyors.
Control Instrumentation:	Usually one main control panel is supplied. It interlocks all other controls of the entire system.

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Reff Products, Toronto, Ontario
2. Jasper Cabinet, Jasper, In., U.S.A.

BDR MACHINERY LTD (Vallsta, Iwabo)

ADDRESS	4580 Fieldgate Drive Mississauga, Ontario L4W 4K4
PHONE	(416) 625-9236
TELEX	06-960423
FAX	(416) 625-6437
CONTACT	Mr. C. Eyram, President
ACTIVITY	Suppliers of Electronically Controlled Chip Burners
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	(Manufacturer) Vamek, Sweden

A. SYSTEM DESCRIPTION (VALLSTA STOKER, IWABO)

BDR supplies two lines of wood-chip burning stoker units manufactured in Sweden. The VALLSTA Stoker, available in five sizes (0.2 - 1.5 GJ/h) consists of a chip storage bin, screw auger feed system, chip burner heat and programmable logic controller. They feature fully automatic operation with thermostat activated electric glow coil ignition, photocell combustion monitoring and programmed chip feed and forced-draft cycles. Ash removal is manual, or automated on larger units. A safety sprinkler system and temperature sensor are provided for burnback protection.

The chip stokers are installed to retrofit existing furnaces for applications such as home or shop heating, small industrial kilns, or farm grain dryers. Larger sizes can be supplied as complete stand-alone containerized units complete with chip storage, stoker and furnace.

The IWABOMATIC X-5 units (up to 0.3 GJ/h) are similar in function but include a refractory lined furnace to allow retrofit of small boilers.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- wood chips	
	Size	- minimum	0.635 cm
		- maximum	5.08 cm
		- recommended	2.54 cm
	Moisture	- maximum	40%
		- recommended	30%
Auxiliary Fuel:		Not required	
Electricity Requirements:		220 VAC/60 Hz/10 A	
Output Capacity:		40 - 300 kw	
Energy Product:		Hot gas	
Fuel Input Rate:			

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Chip bin with screw feeder
Emission Control:	
Ash Handling:	Movable grate operated by an electric motor (automatically)
Control Instrumentation:	Programable logic controller

D. SYSTEM COST

Basic Combustion	- Smallest	$ 5 K
	- Largest	$18 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. DaleHaven Farms, Canning, N.S., Vallsta 40 kw
2. Bill Stozkdizk, Old Barns, N.S., Vallsta 150 kw
3. George Brown College, Toronto, Ontario, Vallsta 40 kw

W.R. BENJAMIN PRODUCTS LTD.

ADDRESS	P.O. Box 2062 Springhill, N.S. BOM 1X0
PHONE	(902) 597-8196
TELEX	
FAX	
CONTACT	Mr. S. Benjamin, Vice President
ACTIVITY	Manufacturers of Wood-Fired Boilers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (Benjamin "Dutch Oven" Industrial Boiler)

W.R. Benjamin Products manufactures a line of small industrial biofuel hot-water boilers in addition to several series of domestic units. In the range of 0.1 - 0.5 GJ/h, these single chamber combustors provide low-pressure hot water for heating greenhouses, stores, shops, small factories and multi-unit dwellings.

A large fire door is provided for manual stoking of fire logs, wood chunks or paper/cardboard. The rectangular fire-box is constructed of 6 mm boiler plate with a flat cast iron bar grate. The supply of natural draft undergrate combustion air is adjusted by an aquastat controlled door located in the ash pit cleanout cover.

The units feature full-surround water-wall construction (capacity of 550 L), have domestic hot water coils, and are equipped with pressure relief valve, aquastat and tridicator.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- small log	
	Size	- minimum	61.0 cm
		- maximum	1.22 m
		- recommended	

Moisture - maximum 30%
- recommended 20%

Auxiliary Fuel:

Electricity Requirements: 110 VAC/60 Hz/less than 15 Amp

Output Capacity: Sizes Available - 0.13 - 0.53 GJ/h

Energy Product: Hot water

Fuel Input: 6.56 - 27.33 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:

Emission Control:

Ash Handling: Manual

Instrumentation: Hot water control, overfire control

D. SYSTEM COST

Basic Combustion - Smallest $ 1.5 K
- Largest $ 5.0 K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

List not provided

BIGELOW-LIPTAK OF CANADA LTD.

ADDRESS:	1831 Mattawa Ave. Mississauga, Ontario L4X 1K7
PHONE:	416-279-9501
TELEX:	06-961166
FAX:	
CONTACT:	Mr. J. (John) Williams, General Manager
ACTIVITY:	Supplier of Wood-Fired Boiler Systems
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	

A. SYSTEM DESCRIPTION (ERS Self-Contained Wood-Fired Boiler System)

Bigelow-Liptak of Canada Ltd. can design, supply and erect wood-fired boiler systems for commercial, institutional and small industrial use, ranging in size from 0.35 - 21 GJ/h.

In the wood-fired boiler, fuel is gravity fed onto an inclined grate where primary combustion air is passed to maintain a carbonized bed. Combustible gases and entrained particulates are mixed with preheated secondary combustion air where they ignite and burn in the combustion chamber section of the system. The hot combustible gaseous product transfers heat to steam or hot water. The cooled flue gases are then drawn through an induced draft fan and vented to atmosphere. Ash is usually drawn manually from the boiler. However, on larger systems automatic ash removal can be incorporated.

A standing column of raw fuel, which can consist of hog fuel, sawdust or wood chips, is maintained in the fuel feeder hopper by a level control, which activates the fuel transfer conveyor from the storage system. The fuel storage silo is sized to store a five day supply of material, and is equipped with a bottom unloader.

The metering fuel transfer conveyor and forced draft fan modulate together in response to the boiler pressure, thus enabling control of the amount of material burned to meet the demands of the system.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, and wood chips	
	Size	- minimum	none
		- maximum	7.62 cm
		- recommended	5.08 cm
	Moisture	- maximum	55%
		- recommended	20 - 50%

Auxiliary Fuel:	Not required but offered on larger units for start-up and or stand-by.
Electricity Requirements:	575 or 460 V - phase varies with size
Output Capacity:	Sizes Available - 0.35 - 21.0 GJ/h
Energy Product:	Hot water, hot oil, and steam
Fuel Input Rate:	0.025 - 1.56 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Metering/surge hopper always supplied, storage silo is optional
Emission Control:	As required to meet local code requirements - usually dust collector
Ash Handling:	Usually manual up to 150 BHP - can be automated as required
Control Instrumentation:	Ranges from basic to PLC controlled

D. SYSTEM COST

Basic Combustion	- Smallest	$ 50 K
	- Largest	$ 1000 K
Turnkey System	- Smallest	$ 65 K
	- Largest	$ 1400 K

E. INSTALLATIONS

List not provided

BIO-CHAR INC.

ADDRESS	7382 Winston Churchill Blvd. Mississauga, Ontario L5N 3X7
PHONE	(416) 875-4600
TELEX	
FAX	(416) 451-4490
CONTACT	Mr. K. (Cliff) Kerr, Engineering Manager
ACTIVITY	Suppliers of Bio Medical Incinerators
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The major activity of Bio-Char is incineration, particularly of bio-medical wastes. The system design features a low-temperature pyrolytic first stage to prevent slagging and a high-temperature second chamber to ensure complete burnout. Sizes range from about 5 - 85 GJ/h. Biofuel can either be batch loaded or automatically fed by a continuous ram system. Ash removal can be automated and flue gas scrubbing can be provided.

For higher quality fuels such as MSW, wood, agricultural wastes and peat, the combustor is fitted with a heat recovery boiler.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- Hog fuel, sawdust, wood chips, small log, MSW, agricultural, pathological wastes
	Size	- minimum
		- maximum
		- recommended
	Moisture	- maximum
		- recommended

Auxiliary Fuel: minimum of two pilots

Electricity Requirements: for single fan, conveyor or ram

Output Capacity: Sizes Available - 3.17 - 52.8 GJ/h

Energy Product: hot gas, hot water, hot oil, steam

Fuel Input: 0.23 - 4.5 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: engineered separately

Emission Control: only where chemicals present (eg. sulphurs)

Ash Handling: various

Control Instrumentation: main control, temperature recording

D. SYSTEM COST

Basic Combustion	- Smallest	$75.0 K
	- Largest	$700 K
Turnkey System	- Smallest	$10.0 K
	- Largest	$5000 K

E. INSTALLATIONS

1. Many Hospitals in Ontario
2. Ajax Central Heating Plant, Ontario, wood wastes
3. New Brunswick peat operation, Lameque, N.B.

BOILERSMITH LTD.

ADDRESS	156 Main St. South P.O. Box 70 Seaforth, Ontario N0K 1W0
PHONE	(506) 527-0600
TELEX	069-55305
FAX	
CONTACT	Mr. B. (Brad) Finlayson, Sales Representative
ACTIVITY	Manufacture, Suppliers of Firetube Boilers
CANADIAN REPRESENTATIVES	SFS Equipment, Kentville, N.S.
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRITPION

VICTOR

The VICTOR series of steam or hot-water firebox boilers are available in a wide range of sizes from 0.7 to 50 GJ/h. With 3-pass fire-tube and wet-back firebox design, they feature an open bottom for integration with a variety of suitable hand or mechanically fired combustion chamber designs (by others). Optional induced draft fans and oil or gas backup burners are available.

Boilersmith also manufacture an extensive line of horizontal return tubular and locomotive type boilers for integration with other manufacturers' combustor designs.

SYNCRO

The SYNCRO Dual-Pak Series II solid fuel (or combination solid fuel/oil) packaged boilers are manufactured in 12 sizes (0.2 - 2.7 GJ/h) for low pressure steam or hot water. A 2-pass fire-tube boiler section is located above a refractory lined firebox fitted with manually shaken cast iron grates. Ash removal is manual from a below grate ash pit.

With solid fuel firing natural draft undergrate primary air is controlled by an automatic damper. Optional forced overfire air and induced draft fan are available. Combination units are fitted with an oil burner firing into the solid fuel firebox, and can switch automatically from solid fuel to oil firing.

TEMPEST

The TEMPEST system, manufactured by DUMONT Industries, is available in two models (0.2 - 0.5 GJ/h) for domestic use or small institutions. Designed to burn manually loaded solid wood blocks, the system includes the hot water boiler, a water-filled heat storage tank, and a heat delivery loop. Based on the principle of intermittent firing at peak capacity, the multichamber unit provides high combustion efficiency, low creosote release and green fuel capability. Combustion gases pass from the base of the vertical primary combustion chamber through a refractory tunnel to a secondary chamber below the water-tube heat exchanger section. Forced draft combustion air is delivered via a single tuyere to the base of the primary combustion chamber with induced draft flow through the boiler. Ash removal is manual.

Units can be fitted with an oil-burner backup and a domestic hot water coil in the heat storage tank.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, agricultural waste, and waste heat gases
	Size	- minimum
		- maximum
		- recommended
	Moisture	- maximum
		- recommended
Auxiliary Fuel:		Gas or oil backup available on automatic systems
Electricity Requirements:		Small units 120 VAC/60 Hz/single phase Large units 460, 600 VAC/60 Hz/3 phase
Output Capacity:		Sizes Available - 0.2 - 21 GJ/h
Energy Product:		Hot water, steam
Fuel Input:		

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Custom fabrication
Emission Control:	Custom fabrication, chimneys available
Ash Handling:	Custom fabrication
Control Instrumentation:	Custom fabrication

D. SYSTEM COST

Basic Combustion	- Smallest	$ 4 K
	- Largest	$ 250 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. Several dozen boilers in use - lists available

CANABURN BIOENERGY INC. (LAKA)

ADDRESS	1565 Lauzon Road P.O. Box 2037 Windsor, Ontario N8Y 4R5
PHONE	(519) 945-5244
TELEX	064-77779
FAX	
CONTACT	Mr. J.A. (John) Kiviste, Sales Manager
ACTIVITY	Supply LAKA Multi-Fuel Boiler Systems
CANADIAN REPRESENTATIVES	Currently being established
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

LAKA

Canaburn is the supplier for a Finnish system which combines a multichamber combustor with an integral hot-water packaged boiler. The size range covers units from small domestic models to medium-sized systems for institutional, commercial and small industrial applications (0.1 - 7.3 GJ/h).

The design features a deep fuel bed in an internal vertical waterwall fuel storage delivery chamber with a gently sloped fixed lower grate. A low level of primary undergrate air gasifies the fuel with the combustible gases produced, passing to a secondary chamber where additional air is supplied to ensure complete, high-temperature combustion. A variety of solid biofuels can be utilized, including wood chunks or small logs, chips, hog fuel (sawdust, bark) and peat.

In small units, fuel is loaded manually through a top hatch. Grates are shaken by hand and ash manually removed from the undergrate ash pit. The natural draft flow of combustion air is controlled by an automatic draft regulator. Domestic hot water coils and automatic oil or electric backup can be incorporated.

On larger systems fuel is supplied to the internal fuel hopper via fully automated auger and travelling bridge dam-bucket reclaim systems. An electronic control system regulates fuel feed and adjusts the frequency and stroke of the hydraulic grate vibrating mechanism. Ash is automatically removed from below the grate by wet or dry systems.

Complete boiler systems can be supplied as containerized units. A specific model line (2.5 - 6.5 GJ/h) is available for combustion of light municipal wastes. These units include a flue-gas filter system, an automatic oil burner for solid fuel ignition, and burnout and sidewall grate doors for removal of large non-combustible contaminants.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, peat pieces	
	Size	- minimum	none
		- maximum	
		- recommended	
	Moisture	- maximum	60%
		- recommended	20 - 30%
Auxiliary Fuel:			
Electricity Requirements:			
Output Capacity:		sizes available - 0.2 - 7.35 GJ/h	
Energy Product:		hot water	
Fuel Input:			

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Smaller systems use a manual load top hatch, midsize systems have a 12 m^3 silo with augers, larger systems use an automatic bridge fuel hoist with radar and computer controls
Emission Control:	Standard equipment @ <300 mg/Nm^3 Optional @ <150 mg/Nm^3
Ash Handling:	Small systems - basic ash pans Large systems - wet or dry ash conveying and disposal system

Control Instrumentation: Small units - basic gauges and regulators.
Midsize systems - basic or automatic
Large systems - automatic computer controls

D. SYSTEM COST

Basic Combustion	- Smallest	$ 16 K
	- Largest	
Turnkey System	- Smallest	
	- Largest	$ 1150 K

E. INSTALLATIONS

1. 22 kw boiler at Research and Productivity Council for testing and C.S.A. clearance

CANABURN BIOENERGY INC. (SASMO)

ADDRESS	1565 Lauzon Road P.O. Box 2037 Windsor, Ontario N8Y 4R5
PHONE	(519) 945-5244
TELEX	064-77779
FAX	
CONTACT	Mr. J.A. (John) Kiviste, Sales Manager
ACTIVITY	Supply SASMO gasifiers, woodchoppers, and loaders
CANADIAN REPRESENTATIVES	Currently being established
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

SASMO

A Finnish line of precombustors (4 models, 0.3 - 2.6 GJ/h) is supplied for retrofitting boilers or furnaces to utilize solid biofuels such as wood chips, sawdust or peat briquettes.

The refractory lined precombustion (gasification) chamber is fitted with a flat grate, cooled by forced-draft primary underfire air. Grate level (and agitation) are controlled by external levers. Above the grate is a cast iron alloy fuel bridge around which the fuel flows to the grate. Combustible fuel volatiles collect in the cavity below the fuel bridge and are drawn out by the boiler draft through a fire-tube which connects the pre-combustion chamber to the boiler firebox.

Secondary air is supplied to the fire-tube to support gas combustion in the tube and on into the boiler firebox where combustion is completed. Air supply is controlled by automatic draft regulators which respond to boiler temperature.

On smaller units, fuel is supplied by gravity flow from a stainless steel hopper mounted above the pre-combustion chamber. Larger units can be fitted with a Sasmo Ramstoker which transfers fuel from a separate storage bin through a fuel feed pipe to the top of the pre-combustor.

Operation of the stoker is controlled by mechanical limit switches and a sprinkler system is utilized for burnback protection.

Ash removal is typically manual from a below grate ash pit, but larger units can be fitted with wet or dry automatic ash removal systems. An optional sloping grate section is available for firing of high ash peat briquettes.

Canaburn can also supply a series of complete heating plants consisting of Sasmo ramstoker, Sasmo precombustor, Hogfors cast iron boilers, plus an induced draft fan, insulated stack and electronic control system.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust, wood chips, peat pieces	
	Size	- minimum	none
		- maximum	
		- recommended	
	Moisture	- maximum	45%
		- recommended	25 - 30%
Auxiliary Fuel:			
Electricity Requirements:			
Output Capacity:		sizes available - 0.2 - 2.625 GJ/h	
Energy Product:		retro-fit gasifier for boiler/furnace conversion	
Fuel Input Rate:			

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	All sizes can be fitted with stainless steel gravity feed bin. A ramstoker is recommended for large units.
Emission Control:	Not applicable
Ash Handling:	Manual removal, large ash bins can be custom made to suit
Control Instrumentation:	Standard draft regulators

D. SYSTEM COST

Basic Combustion	- Smallest	$5.3 K
	- Largest	$46.8 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

COE MANUFACTURING

ADDRESS	P.O. Box 68 Brampton, Ontario L6V 2K7
PHONE	(416) 451-4990
TELEX	
FAX	
CONTACT	Mr. G. (George) Powis, Sales Representative
ACTIVITY	Manufacturer of Energy from Wood Waste Systems
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	COE Manufacturing, Painsville, Ohio

A. SYSTEM DESCRIPTION (ENERGEX)

The ENERGEX forced vortex suspension burner has been marketed for over 15 years (formerly by MOORE INTERNATIONAL). It is available in 3 models (16, 28 and 47 GJ/h) and provides a hot combustion gas output for direct utilization in lumber kilns, veneer dryers, rotary kilns, flash dryers, log ponds and hot hogs. Alternatively, the hot gas output can be passed to a close-coupled boiler for producing steam, hot water or hot oil process energy.

The burner operates on any low ash, dry particulate biomass fuel. The fuel supply system typically includes a hammermill, storage silo and unloader, metering bin and high-pressure pneumatic fuel delivery system. The combustor is a refractory lined cylinder that can be mounted horizontally or vertically. A primary air blower delivers a controlled air flow to a manifold that distributes the air through manually set dampers to a segmented plenum between the inner refractory lining and the steel combustor shell. The preheated air passes through the refractory via tangential tuyeres which establish a cyclonic flow in the combustion chamber. Fuel also enters via a tangential port.

A refractory choke at the burner outlet holds particulate in the chamber until combustion is complete. Outlet hot gas passes directly to a heat exchanger or to a pressure equalization chamber where blend air is added. System control is fully automated with automatic adjustment for fuel and air density to maintain a constant air/fuel ratio over a turn-down ratio of 5:1. An auxiliary burner is used only to pre-heat the combustor on startup.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust, milled shavings	
	Size	- minimum	none
		- maximum	0.3175 cm
		- recommended	0.3175 cm minus
	Moisture	- maximum	15%
		- recommended	15%
Auxiliary Fuel:		Gas Burner for start-up only	
Output Capacity:		Sizes Available - 15.75 - 47.25 GJ/h	
Energy Product:		Hot gas	
Fuel Input Rate:		0.907 - 2.72 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Complete fuel collection, transfer, storage and recovery systems supplied
Emission Control:	Not required
Ash Handling:	Not required
Control Instrumentation:	Included

D. SYSTEM COST

Basic Combustion	- Smallest	$120 K
	- Largest	$160 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. J.H. Normick, Lasarre and Amos, Quebec
2. Northern Wood Preservers, Thunder Bay, Ont.

COEN BURNERS CANADA INC.

ADDRESS	32 Boul. Industriel St.-Eustache, Quebec J7R 5C1
PHONE	(514) 472-7922
TELEX	05-835584
FAX	
CONTACT	Mr. G. (George) Faulkner, ingenieur en application
ACTIVITY	Manufacturers of Biomass Combustion Systems
CANADIAN REPRESENTATIVES	Camatec 4159 Belanger Est Montreal, Quebec H1T 1A2
	Combustion and Energy Systems 55 Nugget Ave, Suite 223A Scarborough, Ontario M1S 3L1
	Inproheat Industries 680 Raymur Avenue Vancouver, B.C. V6A 2R1
	Bruce Sutherland Associates 100 Botsford St. Moncton, N.B. E1C 8N8
REPRESENTATIVES	
PARENT COMPANIES	COEN COMPANY INC. 1510 Rollins Road Burlingame, California US 94010

A. SYSTEM DESCRIPTION

The DAZ (Dual-Air-Zone) Scroll Burner is a pure suspension burner for fine particulate biofuels that has been marketed by COEN for over 20 years, with about 100 installations. Available in 9 models (5.3 - 158 GJ/h), the applications include direct firing into package or field erected boilers for supply of process steam, hot oil or hot water; direct firing into rotary kilns; or when combined with the COEN Inner Air Wall air heater, supplies hot gases for rotary or flash dryers, lumber kilns and veneer dryers.

The burners require finely ground dry fuels and operate on wood residues (sander dust, sawdust, shavings, bark or solid trim) agricultural residues (corn husks, rice and grain hulls, peanut shells) or processing plant residues (coffee grounds, bogasse fines, apple pomace, etc.). The main feature of the burner is the use of two air registers with lower zones that divide the combustion air flow into two counter-rotating concentric streams. The burner feed scroll injects the air-conveyed fuel particles in an annular flow between these counter-rotating air streams. The resultant scrubbing action provides intense turbulent mixing to promote a stable, compact flame pattern. A refractory burner throat serves as a high temperature base for flame stabilization.

A gas or oil pilot flame is required and fossil fuels can be fired in association with the solid fuels. For hot gas applications, the burner is combined with an air heater combustion chamber which includes baffle and curtain walls to ensure effective mixing of the combustion gases with diluent air or recycle gas, and also provide sufficient residence time for complete fuel particle burnout.

Fuel handling requires a storage silo and unloader, fuel metering system, vibrating screen and pneumatic delivery blower. A hog, hammermill and drier may also be required, depending on the fuel source. Emission controls (downstream of the application) can be cyclone or bag filters, as required.

B. SYSTEM SPECIFICATIONS

Fuels:	Type	- hog fuel, sawdust, wood chips, agricultural waste	
	Size	- minimum	fine
		- maximum	0.1587 cm
		- recommended	
	Moisture	- maximum	15%
		- recommended	5 to 10%
Auxiliary Fuel:		5% fossil fuel	

Electricity Requirements:	**600 volts**
Output Capacity:	**Sizes Available - 5.25 - 175.5 GJ/h**
Energy Product:	**Hot gas, hot water, hot oil, steam**
Fuel Input Rate:	**0.272 - 9.07 t/h**

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Silo for storage and measurement, vibrating table and ventilator
Emission Control:	Cyclones and or bag filters
Ash Handling:	The combustion chamber is cleaned weekly
Control Instrumentation:	Control of combustion with a PLC controller and control loop

D. SYSTEM COST

Basic Combustion	- Smallest	$60K
	- Largest	$200K
Turnkey System	- Smallest	$125K
	- Largest	$350K

E. INSTALLATIONS

1. Sogefor Ltee., Lac des Iles, Quebec
2. Levesque Plywood, Hearst, Ontario
3. Blue Ridge Lumber, Blue Ridge, Alberta

CORRIGAN'S WELDING & WOOD STOVE CENTRE

ADDRESS	East Royalty Charlottetown, PEI C1C 1H5
PHONE	(902) 892-3159
TELEX	
FAX	
CONTACT	Mr. P. (Pat) Corrigan, President
ACTIVITY	Manufacturers of Wood-Burning Boilers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Corrigan is the manufacturer of the PATLYN series of wood burning hot water boilers (0.2 - 0.7 GJ/h) for large domestic and small/medium sized commercial complexes. They are designed for operation on air-dry solid wood chunks of 0.6 - 1.2 m length. The single chamber firebox is surrounded by a water jacket including a large water lagged exhaust gas baffle. Ash is handled manually while natural draft (overfire) is thermostatically regulated. The boilers feature a safety relief valve directed into the firebox, temperature and pressure gauges and single/dual aquastats.

Corrigan has designed and will manufacture a larger series (0.8 - 1.3 GJ/h) of vertical-tube multi-fuel boilers for operation primarily on wood chips.

B. SYSTEM SPECIFICATIONS

Fuels Specification:	Type	- small log	
	Size	- minimum	0.56 m
		- maximum	1.21 m
		- recommended	

Moisture - maximum 35%
- recommended 25%

Auxiliary Fuel: None

Electricity Requirements: 110 Vac, 1 phase

Output Capacity: Sizes Available - 0.127 - 0.422 GJ/h

Energy Product: Hot water

Fuel Input Rate: 9.3 - 31.0 kg/h

C. ANCILLARY EQUIPMENT:

Fuel Storage and Handling:

Emission Control: Secondary burn chamber

Ash Handling: Manual

Control Instrumentation: Automatic

D. SYSTEM COST

Basic Combustion - Smallest $ 1.6 K
- Largest $ 6.0 K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Selkirk Industrial Senior Citizen Complex, Belfast, P.E.I.
2. King's Palace Restaurant & Apartment Complex, Charlottetown, P.E.I.
3. Kirkwood Cabinet Manufacturing, Pleasant Grove, P.E.I.

DONLEE TECHNOLOGIES INC.

ADDRESS	693 No. Hills Road P.O. Box 349 York, PA 17405
PHONE	717-755-1081
TELEX	4761165
FAX	717-755-0020
CONTACT	Mr. Martin Gilligan, Senior Vice President Marketing
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	York-Shiply of Canada 1297 Industrial Blvd. P.O. Box 3131 Cambridge, Ontario N3H 4S6
REPRESENTATIVES	
PARENT COMPANIES	Donlee Technologies Inc.

A. SYSTEM DESCRIPTION (YORK-SHIPLY FBC)

Donlee Technologies is the parent company of York-Shiply which markets a fluidized-bed energy recovery system. A variety of system arrangements are available in outputs ranging from 7.5 GJ/h to 120 GJ/h. The combustor system can be provided as a stand-alone unit to produce hot gas for process use or coupled with a modular package boiler to produce hot water or steam. In addition, an in-bed heat exchanger can be provided for greater heat transfer efficiency.

Two fluidized-bed designs are manufactured by York-Shiply. The first is a conventional conical fluid bed combustor suitable for most applications. For fine fuels or high ash content fuels the recirculating fluid bed design is recommended. This design differs from the conventional design in that a cyclone section is added at the flue gas discharge which captures and recycles any entrained material. This design also offers a slightly higher turndown ratio than the conventional system.

Both designs can be provided with an automated bed cleaning system. This equipment consists of twin solenoid valves and a vibrating conveyor. All necessary control instrumentation for all equipment is packaged with the various systems.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, MSW, agricultural waste, animal biomass (manure, litter, offal, etc.)	
	Size	- minimum	none
		- maximum	2" cube
		- recommended	
	Moisture	- maximum	55%
		- recommended	15 - 50%
Auxiliary Fuel:		Start-up burner on oil, gas or propane	
Electricity Requirements:		up to 200 kW	
Output Capacity:			
Energy Product:		Hot gas, hot water, steam	
Fuel Input Rate:			

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Silo to metering bin to conveying system to rotary valve into FBC
Emission Control:	Multicyclone or baghouse
Ash Handling:	Only to flange of bed-cleaner. Units clean while in operation.
Control Instrumentation:	In-House design

D. SYSTEM COST

Basic Combustion	- Smallest	$ 150K
	- Largest	$ 1.2M
Turnkey System	- Smallest	$ 200K
	- Largest	$ 1.6M

E. INSTALLATIONS

1. Chapleau Lumber Co., Chapleau Ontario
2. Maibec Industries, St. Pamphile, Quebec
3. Luceville Lumber Co., Luceville, Quebec

DORR-OLIVER CANADA LIMITED

ADDRESS:	174 West Street South Orillia, Ontario L3V L64
PHONE:	705-325-6181
TELEX:	06-875577
FAX:	705-325-3363
CONTACT:	Mr. K.J. Smith, Manager, FluoSolids Division
ACTIVITY:	Manufacturers of FluoSolids Combustion Systems
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	

A. SYSTEM DESCRIPTION (Fluosolids Combustion System)

Dorr-Oliver can design, manufacture, supply and service fluidized bed combustion systems, ranging in size from small industrial to large industrial (2.11 - 527.5 GJ/h).

In the fluidized bed reactor, an inert bed (usually silica sand) is fluidized by upflowing combustion air. The resulting suspended solids-gas mixture has a vigourous boiling action. Fuel injected into the bed is rapidly and thoroughly mixed, providing an ideal environment for combustion. The flue gas generated in the bed proceeds through the freeboard (upper zone) of the reactor where combustion is completed. Any larger particulates entrained in the flue gas are disengaged and fall back into the bed. Because of attrition, ash is usually reduced to a sufficiently small size that it exits the combustor with the flue gas. The flue gas exits the reactor at a temperature of about 820 C. The hot combustion gases then pass through a heat exchanger and waste heat boiler where the gases are cooled and steam can be produced. After leaving the waste heat boiler the gases are scrubbed and any particulates removed.

Various materials can be burned in the fluidized bed combustor including various coals, woodwastes, oil shale, domestic garbage, sewage wastes, refinery sludges, industrial waste, and food and pharmaceutical wastes.

Residence times and temperatures are sufficient to ensure the complete destruction of any refractory organic compounds. In addition the ash produced is sufficiently inert to enable suitable land disposal.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, and agricultural waste	
	Size	- minimum	none
		- maximum	30.48 cm
		- recommended	3.81 cm
	Moisture	- maximum	none
		- recommended	any
Auxiliary Fuel:		No auxiliary fuel usually needed. Generally gas or oil for preheat only.	
Electricity Requirements:		Air blower is main energy user. May be turbine driven.	
Output Capacity:		Sizes Available - 2.11 - 527.5 GJ/h	
Energy Product:		Hot gas, hot water, hot oil, and steam	
Fuel Input Rate:		0.152 - 38.1 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	System battery unit is usually a small feed bin with metering type feeder.
Emission Control:	Cyclones, precipitators, scrubbers or baghouse included, depending on need.
Ash Handling:	Wet or dry, manual or automatic systems available. May include pneumatic conveying, cooling, pumping and or filtration.
Control Instrumentation:	Semi-automatic conventional or PLC based. Includes stack gas analyzer and safety interlock system.

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Lakeview Sewage Plant (Toronto Area), plus 2 other major sewage combustor installations in Southern Ontario.
2. General Electric, Selkirk New York, waste oils, biological sludge, carbon.
3. Seven others in U.S.A.

THE ENERCAN GROUP

ADDRESS	1200 Sheppard Ave. E., Suite 105 Willowdale, Ontario M2K 2S5
PHONE	(416) 495-0111
TELEX	
FAX	
CONTACT	Mr. K. (Keith) Bircher Director Technology Development
ACTIVITY	Suppliers of Energy From Waste Incinerators
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The Enerkiln Staged Combustion System is supplied by Enercan in sizes from about 10 - 50 GJ/h for operation on municipal and industrial solid wastes. From storage, the raw wastes are processed by a slow speed shredder then conveyed to a drop chute and ram feeder. The first stage combustion consists of a slightly inclined rotary kiln operated under substoichiometric conditions. The flow of solids and gas in the kiln is countercurrent. Ash is automatically dropped from the refractory lined kiln to a wet quench tank and conveyed to an external container.

The first-stage off-gases are ducted to a fixed, cylindrical, secondary combustion chamber where excess air is injected through tangential ports to allow complete burnout at high temperature. Exhaust passes via a refractory duct to a heat recovery boiler, ID fan and lime scrubber, and baghouse emission control system. The full system is automatically controlled by programmable logic modules.

B. SYSTEM SPECIFICATIONS

Fuels Specification:	Type	- MSW	
	Size	- minimum	
		- maximum	30.48 cm
		- recommended	shredded 10.16 cm
	Moisture	- maximum	40%
		- recommended	

Auxiliary Fuel:	Start-up only
Electricity Requirements:	
Output Capacity:	Sizes Available - 20.0 GJ/h and larger
Energy Product:	Steam
Fuel Input:	0.83 - 4.17 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Custom design
Emission Control:	Baghouse, dry lime injection
Ash Handling:	
Control Instrumentation:	Complete with PLC and process controllers

D. SYSTEM COST

Basic Combustion	- Smallest	
	- Largest	
Turnkey System	- Smallest	$5 M
	- Largest	$10 M

E. INSTALLATIONS

1. 3M Canada Ltd., London, Ontario

ENERGY SYSTEMS KMW INC.

ADDRESS	150 White Oak Rd. London, Ontario N6E 3A1
PHONE	(519) 686-1771
TELEX	064 5803
FAX	
CONTACT	Mr. Bertil Rosen, President
ACTIVITY	Suppliers of Biomass Fuel Systems
CANADIAN REPRESENTATIVES	Solid Energy Systems Ltd. 385 Wilsey Road, Unit 9 Fredericton, N.B. E3B 5N6 (506) 452-1100 Nort-Tech Industrial North Bay, Ontario
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The 50 year old KMW Energy line of combustion equipment for biomass fuels (formerly Anga & Varme Swedestoker), represents over 3000 installations worldwide with over 25 installations in North America where systems have been marketed the past 8 years. Energy Systems KMW Inc. provide complete services including design, engineering, manufacturing and installation, and can supply the combustor module alone or a complete turnkey system.

The basic refractory-lined single-chamber combustor is tailored to the biofuel available. Units are available for wet fuels (30 - 60% MC) or for dry fuels (up to 35% MC). They can handle a wide range of rough particulate or prepared fuels including chips, hog fuel, DBF, peat and various agricultural residues and industrial biomass wastes. No auxiliary fossil fuel is required, but gas or oil burners can be fitted for backup use.

Fuel storage is typically in a rectangular bin (often below grade to facilitate truck dumping) with a reciprocating-wedge bottom unloader plus flight or screw conveyors for fuel delivery to a metering bin and final feed system. The KMW combustors employ pile or bed burning on fixed grates. There are two major system configurations. One series utilizes stationary grates with an underfeed screw-auger stoker that delivers fuel to a central retort in the base of the combustion chamber. The retort is either rectangular surrounded by a flat pin-hole grate or circular with a raised conical grate plus a surrounding flat bar grate.

A second series uses sloped reciprocating grates with fuel delivered to the top of the combustion chamber. A full stepped reciprocating grate, or combined fixed inclined grate plus counter reciprocating section are available. Forced-draft fans provide under-grate primary and overfire combustion air.

The basic refractory lined combustion chambers provide hot combustion gases for direct thermal applications, or more commonly, are integrated with a heat exchanger module (on top of, or close-coupled adjacent to) the combustor. Energy output can then be steam, hot air, hot water or hot oil, as required.

Ash handling can be manual raking to a dump grate for conveyor transfer to an outside container, or fully automated continuous removal by an enclosed conveyor system on larger models.

Emission control systems are supplied to meet local regulations. Typically, a dry multiclone module is utilized but high efficiency wet or dry systems can be supplied when required. An induced draft fan and stack complete the standard system. Optional economizer and combustion air-preheater sections are available for larger units.

The combustor operates on a high-fire mode at 40 - 100% of capacity, but can also automatically switch to a natural draft low-fire mode as a hot standby basis. Efficiency varies between 70 and 85% depending on fuel quality and type of heat exchanger. Operator time is typically one hour per day with annual maintenance costs estimated at 3% of equipment cost.

A small-scale containerized system is available. The combustor, heat exchanger, emission control module and control panel are factory-assembled in a standard enclosed container that serves as the energy system building. The container is trucked to the site, lifted onto a prepared foundation and hooked to existing electrical and energy distribution lines. A second container is fitted as a fuel storage and unloader unit. This approach minimizes civil works at the site and allows easy system relocation, if required.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, peat, briquets and pellets	
	Size	- minimum	coarse sawdust
		- maximum	7.62 x 7.62 x 7.62 cm
		- recommended	
	Moisture	- maximum	65%
		- recommended	

Auxiliary Fuel:	
Electricity Requirements:	
Output Capacity:	Sizes Available - 1.05 - 52.5 GJ/h
Energy Product:	Hot gas, hot water, hot oil, steam
Fuel Input:	0.16 - 7.26 t/h

C. • ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Live floor fuel storage and reclaim. Auger fuel transport.
Emission Control:	Multicyclones
Ash Handling:	Manual, semiautomatic, fully automatic. Ash transported by auger.
Control Instrumentation:	Programmable controller for entire system

D. SYSTEM COST

Basic Combustion	- Smallest	$ 15 K
	- Largest	$ 2000 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. Campbellton Regional Hospital, Campbellton, N.B., 10.5 GJ/h, mill waste system to produce high pressure steam
2. Ontario Research Foundation, Mississauga, Ontario, 1.05 GJ/h, various solid fuels processed
3. Red Lake High School, Red Lake, Minnesota, 3.93 GJ/h, wood chips to produce low pressure steam

ENVIROWEST INDUSTRIES LTD.

ADDRESS	9815 - 48TH St. SE P.O. 234, Station T Calgary, Alberta T2H 2G8
PHONE	403-279-4656
TELEX	03821172
FAX	
CONTACT	Mr. Victor Fortinski, General Manager
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	Optimax Industries

A. SYSTEM DESCRIPTION (ENVIROWEST SYSTEMS)

Envirowest Industries Ltd. provides turnkey design, manufacture and installation of Envirowest Incinerator Systems. The size range provided for energy recovery systems range from commercial applications of 1.7 GJ/h output to larger industrial systems producing over 21 GJ/h.

The system design is based on a multiple chamber combustor combined with an integral heat-recovery boiler. Waste is charged into the primary chamber where fuel gasification occurs under substoiciometric conditions. The resulting gases pass into the secondary chamber where final combustion takes place. Heat is then recovered from the flue gas in a heat recovery boiler section which can be used to produce steam or hot water.

Depending on the size and application of the supplied system, various ancillary equipment arrangements can be provided. Standard feed equipment includes a ram feed loader and ash handling can be manual, automatic removal on a batch basis or continuous removal with ash quenching. These systems are designed primarily for combustion municipal/industrial wastes. However, other biofuels can be used to fuel these systems including wood residues, agricultural wastes and pathological wastes.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, MSW, agricultural waste, pathological	
	Size	- minimum	
		- maximum	
		- recommended	homogeneous to 1 ft^3
	Moisture	- maximum	
		- recommended	10 - 20%

Auxiliary Fuel:	Natural gas, oil, propane
Electricity Requirements:	110 - 660 volts, 3 phase
Output Capacity:	
Energy Product:	
Fuel Input Rate:	22.7 kg/h - 3855 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Hydraulic ram feeder
Emission Control:	Flue gas scrubber/acid gas removal or to client specifications
Ash Handling:	Automatic batchwise or continuous with ash handling
Control Instrumentation:	Programmable Logic. Controller's standard

D. SYSTEM COST

Basic Combustion	- Smallest	
	- Largest	
Turnkey System	- Smallest	$ 15K
	- Largest	$ 1.5M

E. INSTALLATIONS

1. Medicine Hat Hospital, Medicine Hat, Alberta
2. Alberta Department of Public Works, Brooks, Alberta
3. Teck Corporation, Vancouver, B.C.

EXO TECHNOLOGIES LTD.

ADDRESS	Box 4021 Spruce Grove, Alberta T7X 3B2
PHONE	403-962-6835
TELEX	0373900
FAX	
CONTACT	Mr. Wilfred Ouellet, President
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (EXO INCINERATORS)

Not available

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- wood chips, small log, MSW	
	Size	- minimum	10 cm
		- maximum	
		- recommended	15 cm
	Moisture	- maximum	
		- recommended	

Auxiliary Fuel:	None after heat up - natural gas, propane, oil
Electricity Requirements:	
Output Capacity:	
Energy Product:	Hot gas
Fuel Input Rate:	25 kg/h - 1900 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Hoppers, bin, etc.
Emission Control:	Wet scrubbers or baghouses
Ash Handling:	Dry or wet, manual or automatic
Control Instrumentation:	As required

D. SYSTEM COST

Basic Combustion	- Smallest	$ 17K
	- Largest	$ 400K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

GROVEWOOD HEAT INC.

ADDRESS:	R.R. #1 Little York, P.E.I. COA 1PO
PHONE:	902-672-2090
TELEX:	
FAX:	
CONTACT:	Mr. V. (Vince) Court, President
ACTIVITY:	Manufacturer and Suppliers of Wood Heating Systems
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	

A. SYSTEM DESCRIPTION

Grovewood Heat Inc. is the manufacturer of the "Woodshed" line of heating systems. The size range covers commercial, and small industrial (0.2 - 1.0 GJ/h).

The unit includes a fuel bin with an agitator that helps to eliminate bridging. A feed auger conveys fuel from a bin to the combustion chamber. This auger tube is equipped with a thermally operated valve and water reservoir for burn back protection. The fuel cell is a refractory lined combustion chamber that can be connected to a boiler or hot air furnace. Fuel enters the chamber over a grate under which air from a combustion fan enters. Secondary air enters above the flame. The resulting hot gases exit through a fire tube to an appropriate boiler or hot air furnace. The ashes are removed manually.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust, wood chips	
	Size	- minimum	0.4 cm
		- maximum	2.5 cm
		- recommended	

Moisture - maximum 60%
- recommended 35%

Auxiliary Fuel:

Electricity Requirements: 110 VAC/ 60 Hz/ single phase

Output Capacity: Sizes Available - 0.2 - 1.0 GJ/h

Energy Product: Hot water, hot gas

Fuel Input Rate: 14.4 - 73.0 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: One cubic foot fuel hopper with an auger feed to the burner

Emission Control:

Ash Handling: Manual

Control Instrumentation: Small computer controller with variable settings for fuel feed combustion air

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Linden Lee Farms (Aike Wilting) Cornwall, P.E.I.
2. Willowdale Farms (James Allen) Stanhope, P.E.I.
3. Island Auto Supply, Charlottetown, P.E.I.

HAKMET LTD. (SWEBO)

ADDRESS	881 Harwood Blvd. P.O. Box 248 Dorion, Quebec J7V 7J5
PHONE	(514) 455-6101
TELEX	05-822642
FAX	
CONTACT	Mr. E. (Erkki) Kukkonen, Vice President
ACTIVITY	Suppliers of Solid Fuel Energy Systems
CANADIAN REPRESENTATIVES	Hakmet Ltd. Prince George, B.C.
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (SWEBO)

Hakmet supplies two series of Scandinavian biofuel energy systems (the SWEBO pre-heater and the TP 2000 stoker), designed to convert hot air furnaces or hot water boilers to particulate solid fuel firing. Fuels include sawdust, chips, pellets, bark and agricultural residues. The biomass fuels may be "green" but air-dried is preferred. The SWEBO pre-heater units are available in a size range from about 0.4 to 1.8 GJ/h. A steel fuel bin is fitted with a bottom mounted outfeed screw auger that also drives a fuel agitator in the bin. The underfeed screw conveys the fuel into a refractory lined combustion pot with a fixed grate. A variable speed blower provides underfire primary air and overfire secondary air. The hot combustion gases are ducted into a close-coupled furnace/boiler. Ash is manually removed from the pre-heater and heat exchanger unit.

A wall mounted control unit provides for fully automated operation in either high-fire or low-fire modes. An overheat activated sprinkler quench is provided to prevent backfire into the feed bin.

B. SYSTEM SPECIFICATIONS

Fuels Specification: Type - sawdust, wood chips, bark, pellets, leaves, olive seeds, straws, etc.

Size - minimum 0.0254 cm
- maximum 2.54 cm
- recommended

Moisture - maximum 50%
- recommended low

Auxiliary Fuel:

Electricity Requirements: 208 VAC/60 Hz/5 A/three phase

Output Capacity: Sizes Available - 0.07 - 0.264 GJ/h

Energy Product: Hot gas, hot water

Fuel Input: 3.62 - 13.7 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Bin (0.8 m^3)

Emission Control: Optional (not usually needed for these sizes)

Ash Handling: Manual

Control Instrumentation: Included

D. SYSTEM COST

Basic Combustion - Smallest $ 9.0 K
- Largest $ 19.5 K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. On request

HAKMET LTD. (TP 2000)

ADDRESS	881 Harwood Blvd. P.O. Box 248 Dorion, Quebec J7V 7J5
PHONE	(514) 455-6101
TELEX	05-822642
FAX	
CONTACT	Mr. E. (Erkki) Kukkonen, Vice President
ACTIVITY	Suppliers of Biofuel Stokers
CANADIAN REPRESENTATIVES	Hakmet Ltd. Prince George, B.C.
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (TP 2000 STOKER)

Hakmet supplies two series of Scandinavian biofuel energy systems (the SWEBO pre-heater and the TP 2000 stoker), designed to convert hot air furnaces or hot water boilers to particulate solid fuel firing. Fuels include sawdust, chips, pellets, bark and agricultural residues. The biomass fuels may be "green" but air-dried is preferred.

The TP 2000 Stoker series is available in several sizes from about 0.1 to 1.8 GJ/h, and is designed for operation on partially dried fuels. A unit consists of a fuel bin with agitator, an outfeed screw auger/feeder, a combustion air blower, and a cast iron combustion tube or bowl. The entire unit is caster mounted for close-coupling to an existing furnace/boiler into which the combustion tube/bowl is inserted. Ash is manually removed and stoker operation is controlled by a boiler or room thermostat in high-fire or holding modes.

B. SYSTEM SPECIFICATIONS

Fuels:	Type	- sawdust, wood chips, bark, sod, peat	
	Size	- minimum	0.0381 cm
		- maximum	2.54 cm
		- recommended	

Moisture - maximum 50%
- recommended low

Auxiliary Fuel:

Electricity Requirements: 208 VAC/60 Hz/10 - 16 A/three phase

Output Capacity: Sizes Available - 0.06 - 1.055 GJ/h

Energy Product: Hot gas, hot water

Fuel Input: 3.27 - 54.7 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Fuel container for bulk loading of fuels

Emission Control: Optional (not usually needed for these sizes)

Ash Handling: Manual

Control Instrumentation: Timing circuits, thermostats, feeding overload, microswitches, smoke detectors

D. SYSTEM COST

Basic Combustion	- Smallest	$ 2.0 K
	- Largest	$ 18.0 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. On request

INTERFOR CONSULTANTS LTD.

ADDRESS	1468 Main Street North Vancouver, B.C. V7J 1C8
PHONE	604-984-9771
TELEX	
FAX	984-4153
CONTACT	
ACTIVITY	Supplier
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (SAXLUND)

Interfor Consultants distribute Saxlund combustors which are manufactured in Norway. The systems provided are available covering the size range of 1 to 20 GJ/h. The Saxlund design is a cylindrical single chamber combustor having a double-skinned steel casing lined internally with refractory. Combustion air is passed through the walls and preheated before entering the furnace. Injection occurs in three zones through tangential tuyeres. Fuel is fed by means of a screw feeder and ash removal is provided by a reciprocating sliding frame which moves ash into a screw trough discharge.

The combustion design has been proven on all forest based residues. Energy recovery can be accommodated by coupling the system to the appropriate equipment to produce hot clean gas, hot oil or steam.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - hog fuel, sawdust, wood chips, small log, bark, dust

Size	- minimum	200 um
	- maximum	500 mm
	- recommended	30 mm

Moisture - maximum 60 - 65%
- recommended 10 - 60%

Auxiliary Fuel: None - but oil and gas can be used as emergency backup if required.

Electricity Requirements:

Output Capacity: 1 - 20 GJ/h

Energy Product: Hot gas, hot water, hot oil, steam

Fuel Input Rate: 100 kg/h - 4500 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Discharging plants with metering devices (like screw conveyors) suitable for round and rectangular bins and bunkers

Emission Control: Cyclone, multicyclones, bag filters and wet scrubber collecting equipment, depending on the size application and requirements

Ash Handling: Dry or wet (water scraper conveyors or screw conveyors depending on the size, application and requirements)

Control Instrumentation: Control panels with starters, switches, lamps, relays, timers and/or PLC control

D. SYSTEM COST

Basic Combustion	- Smallest	$ 100K
	- Largest	$ 2M
Turnkey System	- Smallest	$ 300K
	- Largest	$ 7M

E. INSTALLATIONS

List not provided

JELLICOE RESOURCE ASSOCIATES

ADDRESS	4580 Fieldgate Dr. Mississauga, Ontario L4W 4K4
PHONE	(613) 238-3201
TELEX	06-983639 JRA
FAX	
CONTACT	H.C. (Dan) Jellicoe, President
ACTIVITY	Manufacturer of Biomass-Fueled line of Packaged Boilers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	Boiler design formerly available as MOTTPAC, VEKOS, or GWB
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The Biomass Thermal Utilities system is a horizontal fire-tube Scotch Marine design. The three pass packaged boiler is factory assembled on a structural steel base as a compact, self-contained unit. The internal fire-tube combustion chamber is fitted with an air-cooled cast-iron static grate and delivers hot combustion gases to a refractory lined rear gas reversal chamber.

Particulate fuel is pneumatically transported through a 10 cm diameter pipe to the top of the boiler and passes through a drop-tube into the combustion chamber. A static diffuser combines secondary air with the fuel delivery air to spread the fuel in a swirl pattern. Fines are burned in suspension while the larger fuel particles complete combustion on the grate.

The cyclonic action of a rear-mounted multiple-cell grit arrestor traps large particulate which is air-transported back to the combustion chamber for refiring.

Combustion air is supplied by a forced-draft fan with adjustable dampers controlling undergrate and over-fire air delivery. The boiler is fully automated with modulating control of fuel delivery and primary and secondary combustion air.

Supplementary fuel is not required but the boiler can be fitted with automatically activated optimal gas or oil back-up burners of full rated capacity.

B. SYSTEM SPECIFICATIONS

Fuels:	Type	- hog fuel, sawdust, wood chips	
	Size	- minimum	dust
		- maximum	5 x 3 cm
		- recommended	sawdust
	Moisture	- maximum	50%
		- recommended	10-12%
Auxiliary Fuel:		Not required Back-up - oil, propane, NG	
Output Capacity:		Sizes Available - 0.3 - 15.8 GJ/h	
Energy Product:		hot water, steam	
Fuel Input:		0.5 - 4.5 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	
Emission Control:	Internal multi-clone particulate collection Systems meet Canadian regulations
Ash Handling:	Manual Cleanout
Control Instrumentation:	Automatic control by programmed controllers

D. SYSTEM COST

Basic Combustion	- Smallest	$ 75 K
	- Largest	$ 250 K
Turnkey System	- Smallest	$ 125 K
	- Largest	$ 500 K

E. INSTALLATIONS

List not provided

KERR CONTROLS LIMITED

ADDRESS	P.O. Box 1500 Truro, N.S. B2N 5V2
PHONE	(902) 895-9281
TELEX	019-34574
FAX	
CONTACT	Mr. D. (Dave) Wilson, President
ACTIVITY	Suppliers of Parrsboro Wood-Fired Boilers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Two series of solid wood combustors are manufactured by Parrsboro Metal Fabricators and marketed under the Kerr name. A TW series of hot water boilers (0.14 - 0.44 GJ/h) for large residential or light commercial applications is manually stoked with air dried split or roundwood up to 1.2 m in length. The single chamber firebox with lower half firebrick lining has partial to full water jacket and requires manual ash removal. Natural draft is regulated by an electric damper with safety valve blowdown to the firebox, a domestic hot water coil, and standard instrumentation.

The SCOT TWIN FIRE series of small commercial warm air furnaces is manufactured in two models of 0.5 and 0.7 GJ/h. The air tight single chamber firebox operates under thermostatically regulated natural draft, and is manually stoked with solid fuel wood up to 1.2 m in length. A finned steel heat exchange and electric air-circulation blower provide warm air for space heating applications. The firebox has a cast iron lining and features a metered air induction module and stainless steel smoke top in the door cavity. Ash is removed manually.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips	
	Size	- minimum	
		- maximum	1.22 m
		- recommended	
	Moisture	- maximum	
		- recommended	
Auxiliary Fuel:		None	
Electricity Requirements:		Boiler - 110 Vac, 1 phase, 60 Hz Furnace - 230 Vac, 1 phase, 60 Hz	
Output Capacity:		Sizes Available - 0.08 - 0.36 GJ/h	
Energy Product:		Hot water, steam, warm air	
Fuel Input:		5.8 - 26.0 kg/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	
Emission Control:	None - with 20% mc wood or less
Ash Handling:	Manual
Control Instrumentation:	Safety limit controls. Standard residential type installations.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 6.7 K
	- Largest	$ 7.2 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. Various small installations in Atlantic Canada.

KONUS ENERGY SYSTEMS LTD.

ADDRESS	975 - 3rd Avenue Prince George, B.C.
PHONE	562-0522
TELEX	
FAX	562-0532
CONTACT	Mr. John Booth, General Manager
ACTIVITY	Manufacturer, Supplier
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	Buderus Corporation Marietta, Georgia

A. SYSTEM DESCRIPTION (KONUS)

Konus supplies an integral energy recovery system using a multiple chamber combustor arrangement. Systems are provided covering the size range of 2 to 40 GJ/h output. Generally, the combustor is designed to deliver energy in the form of hot oil, however, if required, high temperature water or steam can be generated.

Fuel is fed to the primary chamber by an under-grate auger. For high moisture content fuel, under-fire air is supplied and the grates are cooled with oil or water. Combustion of evolved gases is completed in the secondary chamber which is lined with heat transfer tubes which carry the heat recovery medium. In addition, a sander-dust burner can be supplied which injects fine fuel into the secondary chamber.

The Konus system has been demonstrated on virtually all forest-based biofuels as well as some agricultural wastes. The systems are typically supplied on a turnkey basis with ancillary equipment and instrumentation supplied to meet customer requirements.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, coffee waste	
	Size	- minimum	
		- maximum	7.5 cm
		- recommended	
	Moisture	- maximum	55%
		- recommended	10 - 50%
Auxiliary Fuel:		Oil or gas back-up if required	
Electricity Requirements:		460 V or 575 V, 3 phase normally	
Output Capacity:			
Energy Product:		Hot water, hot oil, steam	
Fuel Input Rate:		6 mm Btu/h - 40 mm Btu/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Systems are normally supplied on a turnkey installation basis including fuel storage system appropriate for the type of fuel.
Emission Control:	Dual cylcones as a standard control device but where local regulations dictate a more sophisticated system, such as electrified filter bed, can be provided
Ash Handling:	Multicylcones are provided with auto deashing systems as a standard
Control Instrumentation:	Standard system utilizes PLC's. Brand of PLC used depends on customer requirement

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Malette Waferboard, Timmins, Ontario
2. Northwood Pulp, Chatham, N.B.
3. Saskatchewan Forest Products, Hudson Bay, Saskatchewan

LAMB CARGATE INDUSTRIES

ADDRESS	P.O. Box 440 1135 Queens Avenue New Westminster, B.C. V3L 4Y7
PHONE	604-521-8821
TELEX	043-51165
FAX	
CONTACT	Mr. Ian Campbell, Manager of Engineering
ACTIVITY	
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (LAMB WET CELL)

The Lamb Wet-Cell combustor is available in sizes covering the range of 10 GJ/h to 75 GJ/h output. The Wet-Cell design comprises a multiple chamber combustor producing hot gas which has been used for direct heating and steam generation applications. This sytem has been used exclusively for combustion of forest based biofuels.

Wood waste is injected into the chamber through the burner base using an underfeed stoker. The resulting bed is spread over the pinhole grate base where volatilization occurs. Evolved gases are then combusted fully in the secondary chamber to produce a hot, relatively clean gas. Tangential air tuyeres provide combustion air in both the primary and secondary chambers which induce cyclonic gas flow. Where applications require cooler temperatures than that produced by the combustor, a blend box is available to mix ambient air with generated hot gas and provide dilution cooling.

All fuel handling and control instrumentation equipment is supplied to meet user specifications. Ash handling is performed on a continuous dry basis. Operation control is provided by a Program Master 550 Controller which can be upgraded as needed.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, wood biomass
	Size	- minimum - maximum - recommended
	Moisture	- maximum - recommended
Auxiliary Fuel:		For start-up
Electricity Requirements:		20 HP - 400 HP
Output Capacity:		Dependent on fuel size
Energy Product:		Hot gas
Fuel Input Rate:		Moisture dependent

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Metering bin included and as needed
Emission Control:	Depends on fuel size - will meet emission standards
Ash Handling:	Automatic dry
Control Instrumentation:	Texas Instruments PM550 controller

D. SYSTEM COST

Basic Combustion	- Smallest	$ 200K
	- Largest	$ 1M
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

LAMBTON CONVEYOR/STORMOR

ADDRESS:
R.R. #2
Florence, Ontario
NOP 1RO

PHONE: 519-695-2316

TELEX:

FAX:

CONTACT: Mr. C. (Chris) Moorhouse

ACTIVITY: Manufacturer of Biomass Combustion Equipment

CANADIAN REPRESENTATIVES:

REPRESENTATIVES:

PARENT COMPANIES:

A. SYSTEM DESCRIPTION

Lambton Conveyor/Stormor manufactures drying and biomass combustion equipment. A 3.165 GJ/h grain drying system was designed, manufactured and installed at Glenwillow Farms, Strathroy, Ontario. The system was designed to utilize corn cob wastes as a fuel, however, any biomass material (i.e. wood chips, sawdust, agricultural waste) could be processed.

The system is equipped with an integral, combustion gas-to-air heat exchanger, which allows for non-polluted, heated plenum-air supply into a grain drying bin. The products of combustion are discharged into the atmosphere through a separate stack either directly, or indirectly after routing the flue gases through a biomass fuel predryer.

The biomass combustion unit has a concentric cylindrical combustion chamber, surrounded by a tubular heat exchanger. Forage wagons serve as collection hoppers for the biomass fuel. The biomass from the wagons is fed by a variable speed auger to the top of the combustion unit. The combustion temperature is typically maintained at 982 C, while the outlet of the heat exchanger usually is about 177 C.

The system is equipped with a central control panel and includes emergency power off, safety control. Should the plenum air temperature exceed a predetermined temperature (typically 82 C, to avoid product damage) an Aquastat opens the control electric circuit which in turn shuts off the whole unit, including fans and hydraulics.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, corn cobs	
	Size	- minimum	
		- maximum	12.7 cm
		- recommended	
	Moisture	- maximum	30%
		- recommended	15%

Auxiliary Fuel:

Electricity Requirements:

Output Capacity: Sizes Available - 3.165 GJ/h

Energy Product: Hot air

Fuel Input Rate: 0.317 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Fuel is collected in forage wagons. A variable speed auger feeds fuel to the top of the combustor.

Emission Control:

Ash Handling:

Control Instrumentation: Main control panel

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Glenwillow Farms, Strathroy, Ontario

LES INDUSTRIES F.P. INC.

ADDRESS	20 Windsor Road Bromptonville, Quebec J0B 1H0
PHONE	(819) 846-2771
TELEX	05-836285
FAX	
CONTACT	Mr. C. (Claude) Desrochers, Director of Industrial Sales
ACTIVITY	Manufactures of Solid Waste Boilers
CANADIAN REPRESENTATIVES	FP Industries 3425 Harvester Road, Suite 102-C Burlington, Ontario L7N 3N1
	FP Industries 323 Highland View Road Moncton, N.B. E1A 2L4
REPRESENTATIVES	FP Industries 59 Daniel Webster Highway Merrimack, N.H., U.S.A.
PARENT COMPANIES	Venmar Inc. Drummondville, Quebec

A. SYSTEM DESCRIPTION

The ES series of packaged boilers is manufactured in a 13 model series ranging from about 0.5 to 32 GJ/h. There are over 30 North American installations of these systems which come in two configurations, a water-leg design for dry fuels and a wet fuel design with an insulated refractory base.

Solid chunkwood fuel can be manually stoked onto the fixed grates or an automated fuel feed system is available for particulate fuels, including sawdust, chips, hog fuel, MSW or agricultural residues. Energy output from the 3-pass fire-tube boiler can be low-pressure steam or hot water (or water/glycol).

The automated fuel feed system consists of a metering bin with fuel agitator, a screw auger outfeed that delivers to a rotary valve and a pneumatic feeder/injector. A forced-draft blower provides primary combustion air while an ID fan and dual cycloner collect flyash which is pneumatically reinjected into the combustion zone. Boiler control is fully automated with manual or semi automatic ash handling.

B. SYSTEM SPECIFICATIONS

Fuels Specification: Type - hog fuel, sawdust, wood chips, small log, MSW, agricultural waste

Size - minimum
- maximum 1.27 x 0.32 x 5.08 cm
- recommended 1.27 x 0.63 x 1.27 cm

Moisture - maximum 55%
- recommended 30%

Auxiliary Fuel:

Electricity Requirements: 600 VAC/60 Hz/three phase

Output Capacity: Sizes Available - 0.32 - 21 GJ/h

Energy Product: Hot water, steam

Fuel Input: 27.2 kg/h - 1.8 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Silos, feedstock is handled using screw conveyors, belt conveyors, or bucket elevators

Emission Control: Cyclonic particle separation

Ash Handling: Could be manual or semi-automatic

Control Instrumentation: Usually one main control panel is supplied. It interlocks all other controls of the entire system.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 40 K
	- Largest	$ 400K
Turnkey System	- Smallest	$ 80K
	- Largest	$ 1000K

E. INSTALLATIONS

1. Bestar Ltd., Lac Megantic, Quebec, a 4.4 GJ/h system producing steam
2. Les Placages de L'Outaouais, Gatineau, Quebec, a 19.4 GJ/h system producing high pressure steam
3. Swedwood Ltd., Dartmouth, N.S., a 7.06 GJ/h system producing 30 psi hot water

MACO ENTERPRISES

ADDRESS	R.R. #2 Dayton, Ontario NOG 1PO
PHONE	(519) 638-2746
TELEX	
FAX	
CONTACT	Mr. M. (Mahlon) Frey, President
ACTIVITY	Suppliers of Automatic Underfed Stokers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The MACO underfeed automatic stoker operates on wood pellets and is utilized to retrofit firebox boilers or funaces to provide hot water or steam. It is available in sizes from about 0.3 to 8 GJ/h.

A tapered bottom storage bin is fitted with a double auger, drop transfer system to prevent burnback. The screw auger stoker feeds pellets to a cast iron retort with peripheral combustion air flow provided by a forced-draft fan. Ash removal can be manual or automatic and control instrumentation includes a hold-fire timer.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- wood pellets	
	Size	- minimum	0.635 x 1.27 cm
		- maximum	1.905 x 3.81 cm
		- recommended	0.635 x 2.54 cm
	Moisture	- maximum	
		- recommended	12%

Auxiliary Fuel:

Electricity Requirement: 110/220 VAC single phase

Output Capacity: Sizes Available - 0.2 - 6.33 GJ/h

Energy Product: Hot water, steam

Fuel Input: 11.3 - 340.2 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Storage Bin, screw conveying

Emission Control: None

Ash Handling: Manual or automatic

Control Instrumentation: Hold fire timer

D. SYSTEM COST

Basic Combustion - Smallest $ 1.5 K
- Largest $ 7.0 K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. New Hamburg, Ontario
2. R.R. #4 Elmira, Ontario
3. Wallenstein, Ontario

NEW YORKER BOILER CO., LTD.

ADDRESS	P.O. Box 1850 Sussex, N.B. E0E 1P0
PHONE	(506) 433-1216 or (506) 433-5185
TELEX	
FAX	(506) 433-5875
CONTACT	Mr. T. (Ted) Shuve, Custom Fabrication Manager
ACTIVITY	Manufacturers of Wood-Chip Fired Systems
CANADIAN REPRESENTATIVES	Scott Agencies Ltd. Montreal, Quebec
REPRESENTATIVES	
PARENT COMPANIES	Dennison Holdings Ltd.

A. SYSTEM DESCRIPTION

For over 20 years the New Yorker Boiler Co. has been manufacturing residential and small commercial boilers for hot water and steam applications.

The small WF series of single chamber water leg hot water boilers is manufactured in two sizes, 0.2 and 0.4 GJ/h. Manually stoked with round wood they feature thermostatically regulated natural draft, tankless hot water coil, safety relief valve and tridicator. Ash is manually removed from the solid grate.

A larger series (0.9 - 35 GJ/h) of hot water or steam boilers operate on wet or partially dried hog fuel (wood residues) or wood chips. Fuel is supplied from a live-bottom storage silo by a flight or screw conveyor system. A two-stage combustion process is utilized with a primary combustion cell plus final burnout in a top or adjacent mounted boiler/heat exchanger unit. Smaller units employ a fixed cast-iron grate with underfeed stoker while larger units utilize a moving chain grate with overhead gravity feed.

Forced draft combustion air and induced draft exhaust fans are supplied. Larger units (above 1.8 GJ/h) are fitted with a multiclone particulate collection system. The systems are completely automated with control by Programmable Logic Controller.

B. SYSTEM SPECIFICATIONS

Fuels:	Type	- hog fuel, sawdust, wood chips, small logs	
	Size	- minimum	0.635 cm
		- maximum	20.32 x 5.08 cm
		- recommended	20.32 x 5.08 cm
	Moisture	- maximum	50%
		- recommended	35%
Auxiliary Fuel:		None	
Electricity Requirements:		Subject to system size	
Output Capacity:		Sizes Available - 0.11 - 21.0 GJ/h	
Energy Product:		Hot water, steam	
Fuel Input:		7.2 kg/h - 2.5 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Live deck storage silos auger or chain conveyors
Emission Control:	Multiclone dust collector
Ash Handling:	Semi-automatic to customer specifications
Control Instrumentation:	Pre-programmed to customer and job requirements.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 1.2 K
	- Largest	
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

OLIVINE CORPORATION

ADDRESS	1015 Hilton Avenue Bellingham, Washington 98225
PHONE	206-733-3332
TELEX	
FAX	206-671-9462
CONTACT	Corky Smith, Chairman
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	Interior Mill Equipment Grand Forks, B.C.
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Olivine Corporation supplies a wide range of combustion and incineration equipment which can be coupled to various heat recovery systems. Total turnkey systems can be designed and provided for the entire range of outputs covered by this directory (0.2 to 21 GJ/h). The basic Olivine combustor is a single chamber refractory lined system with a "Vee" grate hearth. Fuel is introduced above the hearth by a hydraulic ram feeder or other suitable arrangement. Standard ash removal equipment is provided which consists of a ram located at the base of the Vee grate.

The Olivine combustor was originally designed for combustion of forest based biofuels. The system has been adapted to burn other wastes satisfactorily including municipal solid waste. Pollution abatement can be provided to meet regulatory requirements and previous installations have included baghouses and dry scrubbers.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, MSW, agricultural waste (any material that will burn)

Size	- minimum	
	- maximum	
	- recommended	
Moisture	- maximum	60%
	- recommended	50% or less

Auxiliary Fuel: Diesel oil or propane for startup

Electricity Requirements:

Output Capacity:

Energy Product: Hot gas

Fuel Input Rate:

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: By others

Emission Control: Provided to meet requirements

Ash Handling: Dry or wet automatic ash removal

Control Instrumentation: PLC - manual override

D. SYSTEM COST

Basic Combustion	- Smallest	$ 25,600
	- Largest	$ 43,200
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

PARRSBORO METAL FABRICATORS LIMITED

ADDRESS	P.O. Box 637 Cross Roads Parrsboro, N.S. BOM 1SO
PHONE	(902) 254-2214
TELEX	
FAX	
CONTACT	Mr. J. (Jeremy) Godfrey, Engineer
ACTIVITY	Manufacturers of Wood-fired Boilers
CANADIAN REPRESENTATIVES	Kerr Controls Ltd. P.O. Box 1500 Truro, N.S. B2N 5V2
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Two series of solid wood combustors are manufactured by Parrsboro Metal Fabricators and marketed under the Kerr name. A TW series of hot water boilers (0.14 - 0.44 GJ/h) for large residential or light commercial applications is manually stoked with air dried split or round wood up to 1.2 m in length. The single chamber firebox with lower half firebrick lining has partial to full water jacket and requires manual ash removal. Natural draft is regulated by an electric damper with safety valve blowdown to the firebox, a domestic hot water coil, and standard instrumentation.

The SCOT TWIN FIRE series of small commercial warm air furnaces is manufactured in two models of 0.5 and 0.7 GJ/h. The air tight single chamber firebox operates under thermostatically regulated natural draft, and is manually stoked with solid fuel wood up to 1.2 m in length. A finned steel heat exchange and electric air-circulation blower provide warm air for space heating applications. The firebox has a cast iron lining and features a metered air induction module and stainless steel smoke top in the door cavity. Ash is removed manually.

B. SYSTEM SPECIFICATIONS

Fuels:	Type	- small log	
	Size	- minimum	10.1 cm
		- maximum	15.3 cm
		- recommended	
	Moisture	- maximum	20%
		- recommended	<20%

Auxiliary Fuel:	None
Electricity Requirements:	Boiler - 110 Vac, 1 phase, 60 Hz Furnace - 230 Vac, 1 phase, 60 Hz
Output Capacity:	Sizes Available - 0.08 - 0.36 GJ/h
Energy Product:	Hot gas, hot water
Fuel Input:	5.8 - 26.0 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	
Emission Control:	None - with 20% mc wood or less
Ash Handling:	Manual
Control Instrumentation:	Safety limit controls. Standard residential type installations.

D. SYSTEM COST

Basic Combustion	- Smallest	$6.5 K
	- Largest	
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. Various small installations in Atlantic Canada.

PEABODY ENGINEERING CANADA

ADDRESS: 1225 Matheson Blvd.
Mississauga, Ontario
L4W 1Y9

PHONE: 416-625-1550

TELEX: 06-961181

FAX:

CONTACT: Mr J. Postlethwaite, General Sales Manager

ACTIVITY: Manufacturers and Suppliers of Solid Fuel Burners and Systems

CANADIAN REPRESENTATIVES:

REPRESENTATIVES:

PARENT COMPANEIS: Peabody Engineering
39 Maple Tree Avenue
Stamford, CT
06906

A. SYSTEM DESCRIPTION

Peabody manufactures and supplies complete process combustion equipment. The size range covers small to large scale industrial applications (3.7 -316.5 GJ/h).

The combustion equipment includes several types of burners, incinerators, air heaters and flares. The burners are designed to fire liquid, gaseous, and solid fuels as well as wastes for main fuel, supplementary fuel, or for disposal. Solid fuel (biomass) combustion systems have been successfully applied to hot water and steam generators, furnaces, dryers and waste heat exchangers. The complete system design includes: fuel preparation, sizing and drying; storage; metering and conveying; control and instrumentation; fuel-air premix suspension burner (scroll feed type); heat recovery; and pollution control.

After sufficient fuel preparation (i.e. sizing and drying) the solid fuel, combined with combustion air in a dual air damper, enters the burner under pressure. The fuel-air mixture is propelled at high velocity into the hot refractory zone of the burner. A support burner using oil or gas serves to ignite the solid fuel. Ash is removed via grates, hoppers and fly-ash separators or wet scrubbers.

Manual, semi-automatic, and fully automatic operating modes can be used with both the support fuel and solid fuel burner systems.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, paper waste, peanut hulls, oil, coal	
	Size	- minimum	dust fines
		- maximum	1.27 cm
		- recommended	0.635 - 0.9525 cm
	Moisture	- maximum	15%
		- recommended	10%
Auxiliary Fuel:		Gas, propane or oil	
Electricity Requirements:		110 VAC/60 Hz/three phase	
Output Capacity:		Sizes Available - 3.69 - 316.5 GJ/h	
Energy Product:		Hot water, hot oil, steam	
Fuel Input Rate:		0.273 - 23.4 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Fuel is size reduced by means of hogging, shredding or grinding. Fuel with excess moisture content is dried. Prepared fuel is transported to a silo. The fuel is delivered to the burner with metering augers.
Emission Control:	Dry single cyclone, multi-cyclone or wet scrubber.
Ash Handling:	Could be manual or automatic, using grates.
Control Instrumentation:	Usually one main control panel is supplied.

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Spartan Industries, Fairfax, Vermont
2. Tera Engineering Co., Compton, California
3. Saxton Air Systems, Harrisburg, Pennsylvania .

PYRO THERMTEC CONTRACTING LTD.

ADDRESS	Bay 2 - 5700 Barlow Tr. SE Calgary, Alberta T2C 1Z9
PHONE	403-236-3020
TELEX	
FAX	
CONTACT	A. Magega, President
ACTIVITY	Manufacturer, supplier
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (THERMTEC)

Pyro Thermtec manufactures the Thermtec Energy Recovery System which utilizes a multiple chamber combustion design coupled with a modular fire-tube package boiler The size range covered by this system is 1.6 GJ/h to 16 GJ/h.

Waste material is charged into the primary cell, using a hydraulic ram feeder, where preheated combustion air is introduced. Evolved gases are fully combusted in the secondary cell. Flue gas can be directed through the tube and shell boiler or bypassed to the flue gas cleanup section. This arrangement allows the system to process waste during periods of low energy demand.

Various pollution abatement devices can be supplied with the system and equipment selection should be based on fuel type. This equipment includes wet scrubbers, baghouses and acid gas washers. While the system can be fueled with most biofuels, its main application has been burning municipal/industrial wastes. The only limiting fuel characteristic is the requirement of the heating value being greater than 2.1 MJ/kg.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - hog fuel, sawdust, wood chips, small log, MSW, agricultural waste

Size - minimum
- maximum
- recommended

Moisture - maximum
- recommended

Auxiliary Fuel: Propane, # 2 fuel oil, natural gas

Electricity Requirements:

Output Capacity:

Energy Product: Hot water, steam

Fuel Input Rate: 900 kg/d - 31,750 kg/d

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Hydraulic ram feeder

Emission Control: Acid gas cleanup, scrubbers, baghouses

Ash Handling:

Control Instrumentation:

D. SYSTEM COST

Basic Combustion	- Smallest	$ 23K
	- Largest	$ 800K
Turnkey System	- Smallest	$ 36K
	- Largest	$ 1.5M

E. INSTALLATIONS

1. Foothills Hospital, Calgary, Alberta
2. Royal Alex Hospital, Edmonton, Alberta
3. Lethbridge General Hospital, Lethbridge

SALTON FABRICATION LTD.

ADDRESS	19087 - 96th Avenue Surrey, B.C. V3T 4W2
PHONE	604-888-0122
TELEX	04365511
FAX	604-888-2959
CONTACT	Laurie Ross, Sales Manager
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (WELLONS)

Salton Fabrication Ltd. manufactures a variety of energy recovery arrangements all using the basic Wellons Inc. Cyclo-Blast combustor design. System sizes range in output from 5 GJ/h to 250 GJ/h and can be coupled with water-tube boilers and oil heat exchangers or used for direct contact gas heating applications such as veneer and rotary dryers.

The combustion system itself is a multiple chamber silo design featuring water-cooled grates and an annular space between the furnace shell and refractory to carry and preheat combustion air. Fuel is fed by a metering surge bin into a helicoid screw feeder which delivers the fuel to the primary chamber via a refractory chute. Fuel is gasified and evolved gases are combusted in the secondary chamber. Flue gas cleanup equipment is available and system selection is based on application arrangement. This equipment includes multiclones and dry or wet precipitators.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - hog fuel, sawdust, wood chips, agricultural waste

Size - minimum None
- maximum 12.5 cm
- recommended 7.5 cm

Moisture - maximum 60 %
- recommended 45 %

Auxiliary Fuel: Small - gas burners/backup
Large - light by oily rag or other suitable means

Electricity Requirements: 20 - 350 kW

Output Capacity:

Energy Product: Hot gas, hot water, hot oil, steam

Fuel Input Rate: 300 kg/h - 1200 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Storage by either: reciprocating hydraulic live bottom floor or; circular silos with fixed agitation and chain flail

Emission Control: Multiclone and/or dry or wet precipitators

Ash Handling: Manual or automatic dry ash removal

Control Instrumentation: Microprocessor based analog controls

D. SYSTEM COST

Basic Combustion - Smallest $ 50K
- Largest $ 500K

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Canwood Industries, Penticton, B.C.
2. Koch Greenhouses, Aldergrove, B.C.
3. Lakeland Mills, Prince George, B.C.
4. The Pas Lumber, Prince George, B.C.

J.M. SCHERMERHORN (Cleaver-Brooks)

ADDRESS	P.O. Box 6223 Station J Ottawa, Ontario
PHONE	(613) 729-3161
TELEX	
FAX	
CONTACT	Mr. J.M. (John) Schermerhorn, President
ACTIVITY	Suppliers of Entrained Flow Flash Gasification Systems
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	H.F. Clark Ltd., Vancouver, Edmonton, Calgary, and Regina R.G. Sales Ltd., Winnipeg Waterloo MEG. Ltd., Waterloo Johnson Patterson Ltd., Toronto, and Sudbury Matco Ltd., Montreal, and Quebec City B. Sutherland Ltd., Moncton, N.B.
PARENT COMPANIES	Cleaver Brooks of Canada Ltd., Stratford, Ont.

A. SYSTEM DESCRIPTION (Entrained Flow Flash Gasifier)

J.M. Schermerhorn Ltd. supplies a 5-model line of Cleaver-Brooks entrained-flow, staged-combustion biofuel burners in the range of 4.3 - 28.3 GJ/h. The burners are used to retrofit existing boilers, or are supplied as a complete system in association with a fire-tube or water-tube boiler, for production of hot water or low or high-pressure steam. Over 40 installations in North America include applications in schools, food processing plants, furniture factories and forest industry operations.

A variety of low-ash, dry, particulate biofuels can be utilized, including wood chips or pellets, and mill residues such as sawdust, sanderdust and shavings. The fuel preparation system includes a surge bin and fuel metering unit, a hammermill (for reduction of fuel particle size to below 10-mesh) and a primary air fan for pneumatic transfer of the fuel to the burner.

The fuel/primary air stream is mixed with staged secondary air in a cyclonic flow gasification reactor. A final addition of secondary air at the reactor exit nozzle establishes a stable flame which completes burnout of the combustible gases within the boiler firing chamber. Exhaust gas from the boiler is passed to a mechanical collector for particulate removal, then to the induced draft fan and stack.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, sander dust, pelletized wood, shavings	
	Size	- minimum	none
		- maximum	1.27 x 1.27 cm
		- recommended	0.635 x 0.635 cm
	Moisture	- maximum	12%
		- recommended	8%
Auxiliary Fuel:		Supplemental fuel, propane or light oil, used until biomass is fired	
Output Capacity:		Sizes Available - 4.3 - 28.3 GJ/h	
Energy Product:		Hot water, steam	
Fuel Input:		0.08 - 2.0 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Fuel preparation equipment, variable speed fuel meter, hammer-mill and conveying fan
Emission Control:	Optional multi-clone particulate collection system, and induced draft fan
Ash Handling:	Provisions for installing soot blowers in new boiler, also ash hopper for manual de-ashing in front of boiler

Control Instrumentation:	Free standing control panel with U.L. approved flame safeguard and monitoring systems

D. SYSTEM COST

Basic Combustion	- Smallest	$ 100 K
	- Largest	$ 150 K
Turnkey System	- Smallest	$ 127 K
	- Largest	$ 230 K

E. INSTALLATIONS

1. Richardson Brothers Furniture, Sheboygon Falls, WI, 2 units, 350 HP burner/boiler, 375 HP burner
2. Northwest Hardwoods, Longview, WA, 1 unit, 700 HP burner/boiler package
3. Rockingham Poultry, Broadway, VA, 1 unit, 250 HP burner retrofit to burn sludge/sawdust

SCOTIA FARM SERVICES LTD.

ADDRESS	Box 501 Kentville, N.S. B4N 3X3
PHONE	(902) 678-7797
TELEX	
FAX	
CONTACT	Mr. D. (Don) Pettipas, Vice President
ACTIVITY	Suppliers of Packaged Boilers
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The Equipment Division of Scotia Farm Services is a supplier for the DUMONT 2100-Series of Commercial Multi-Fuel Boilers. The 15 model line (0.7 - 7.1 GJ/h) of 3-pass fire-tube packaged boilers features full wet-back design with a refractory lined solid-fuel combustion chamber and separate firing chamber for a backup oil or gas burner.

The solid-fuel capability includes coal as well as a variety of wet or dry biofuels (hog fuel, sawdust, small chips, pellets or other sized biomass). Fuel is gravity fed onto a travelling chain grate with hydraulic ratchet drive. Ash is accumulated in a refractory lined rear chamber for manual cleanout.

Balanced draft operation is established by an induced-draft outlet fan, a forced-draft underfire air fan with sectional grate dampers, and a high-pressure overfire air fan.

The factory assembled and fire tested boilers can be supplied for low or high pressure steam or hot water. They are equipped with a PC compatible microprocessor that automatically modulates fuel feed, grate travel, over and underfire air and induced draft plus automatic switchover to the backup burner.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips	
	Size	- minimum	
		- maximum	1.905 cm
		- recommended	0.635 - 1.27 cm
	Moisture	- maximum	50%
		- recommended	45%

Auxiliary Fuel:	Back-up oil burner - capable of burning coal
Electricity Requirements:	Per customer requirement
Output Capacity:	Sizes Available - 0.071 - 7.06 GJ/h
Energy Product:	Hot water, steam
Fuel Input:	0.051 - 0.51 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Fuel silos and conveying equipment
Emission Control:	None
Ash Handling:	Travelling grate
Control Instrumentation:	Redundant circuitry and microprocessor control

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. Delhaven Farms Ltd., Canning, Nova Scotia

SHAFTER BROS. INC.

ADDRESS	259 Van Horne Ave. Montreal, Quebec H2V 1H9
PHONE	(514) 274-8347 (800) 361-1778
TELEX	
FAX	
CONTACT	Mr. E. Kay, Vice President - Sales
ACTIVITY	Manufacturers of Boilers
CANADIAN REPRESENTATIVES	All major wholesalers and boiler companies Westburne, EMCO, IDEAL, Crane, Western, etc.
REPRESENTATIVES	
PARENT COMPANIES	Shafter Bros. Hydronics (same address)

A. SYSTEM DESCRIPTION

Viking solid fuel package boilers are available from Shafter Bros. in three lines, the Viking Junior, 28 Series and 34 Series (0.4 to 1.3 GJ/h). With hot water or steam output, they are suitable for small industrial plants, institutions, commercial buildings, or multi-unit dwellings.

Of sectional cast iron construction, they feature wet-base design and three-pass flow with manually shakeable cast iron bar grates. They operate with manual or stoker firing on biofuels such as sawdust, chips, pellets or small logs and on coal or coke. Natural draft is controlled by sliding draft regulators or an optional aquastat controlled automatic draft-door regulator. Ash removal is manual. Units are fitted with safety valve and pressure gauge with a domestic hot water coil available as an option.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - sawdust, wood chips, small log, oil, gas, coal, coke

Size - minimum
- maximum
- recommended

Moisture - maximum
- recommended

Auxiliary Fuel: Not required

Electricity Requirements: 110 VAC

Output Capacity: Sizes Available - 0.04 - 0.945 GJ/h

Energy Product: Hot water, steam

Fuel Input: 20 - 95 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Boilers can be stoker fired, automatically fired by oil or gas, hand fired by coal or wood

Emission Control: None

Ash Handling: Manual

Control Instrumentation: Optional Aquastat controlled draft regulator

D. SYSTEM COST

Basic Combustion	- Smallest	$ 0.8 K
	- Largest	$ 11 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

SOLID ENERGY SYSTEMS LTD.

ADDRESS	385 Wilsey Road, Unit 9 Fredericton, New Brunswick E3B 5N6
PHONE	(506) 452-1100
TELEX	014-46281
FAX	(506) 450-3925
CONTACT	Mr. M.R. (Michael) Bleakney, Sales Manager
ACTIVITY	Suppliers of Biomass Fuel Systems
CANADIAN REPRESENTATIVES	Solid Energy Systems Ltd. are manufactures agent for Energy Systems KMW Inc. of London, Ontario
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

The 50 year old KMW Energy line of combustion equipment for biomass fuels (formerly Anga & Varme Swedestoker), represents over 3000 installations worldwide with over 25 installations in North America where systems have been marketed the past 8 years. Energy Systems KMW Inc. provide complete services including design, engineering, manufacturing and installation, and can supply the combustor module alone or a complete turnkey system.

The basic refractory-lined single-chamber combustor is tailored to the biofuel available. Units are available for wet fuels (30 - 60% MC) or for dry fuels (up to 35% MC). They can handle a wide range of rough particulate or prepared fuels including chips, hog fuel, DBF, peat and various agricultural residues and industrial biomass wastes. No auxiliary fossil fuel is required, but gas or oil burners can be fitted for backup use.

Fuel storage is typically in a rectangular bin (often below grade to facilitate truck dumping) with a reciprocating-wedge bottom unloader plus flight or screw conveyors for fuel delivery to a metering bin and final feed system. The KMW combustors employ pile or bed burning on fixed grates. There are two major system configurations. One series utilizes stationary grates with an underfeed screw-auger stoker that delivers fuel to a central retort in the base of the combustion chamber. The retort is either rectangular surrounded by a flat pin-hole grate or circular with a raised conical grate plus a surrounding flat bar grate.

A second series uses sloped reciprocating grates with fuel delivered to the top of the combustion chamber. A full stepped reciprocating grate, or combined fixed inclined grate plus counter reciprocating section are available. Forced-draft fans provide under-grate primary and overfire combustion air.

The basic refractory lined combustion chambers provide hot combustion gases for direct thermal applications, or more commonly, are integrated with a heat exchanger module (on top of, or close-coupled adjacent to) the combustor. Energy output can then be steam, hot air, hot water or hot oil, as required.

Ash handling can be manual raking to a dump grate for conveyor transfer to an outside container, or fully automated continuous removal by an enclosed conveyor system on larger models.

Emission control systems are supplied to meet local regulations. Typically, a dry multiclone module is utilized but high efficiency wet or dry systems can be supplied when required. An induced draft fan and stack complete the standard system. Optional economiser and combustion air-preheater sections are available for larger units.

The combustor operates on a high-fire mode at 40 - 100% of capacity, but can also automatically switch to a natural draft low-fire mode as a hot standby basis. Efficiency varies between 70 and 85% depending on fuel quality and type of heat exchanger. Operator time is typically one hour per day with annual maintenance costs estimated at 3% of equipment cost.

A small-scale containerized system is available. The combustor, heat exchanger, emission control module and control panel are factory-assembled in a standard enclosed container that serves as the energy system building. The container is trucked to the site, lifted onto a prepared foundation and hooked to existing electrical and energy distribution lines. A second container is fitted as a fuel storage and unloader unit. This approach minimizes civil works at the site and allows easy system relocation, if required.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, peat, briquets and pellets	
	Size	- minimum	coarse sawdust
		- maximum	7.62 x 7.62 x 7.62 cm
		- recommended	

Moisture - maximum 65%
- recommended

Auxiliary Fuel:

Electricity Requirements:

Output Capacity: Sizes Available - 1.05 - 52.5 GJ/h

Energy Product: hot gas, hot water, hot oil, steam

Fuel Input: 0.16 - 7.26 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Live floor fuel storage and reclaim. Auger fuel transport.

Emission Control: Multicyclones

Ash Handling: Manual, semiautomatic, fully automatic. Ash transported by auger.

Control Instrumentation: Programmable controller for entire system.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 15 K
	- Largest	$ 2000 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. Campbellton Regional Hospital, Campbellton, N.B., 10.5 GJ/h, mill waste system to produce high pressure steam

2. Ontario Research Foundation, Mississauga, Ont., 1.05 GJ/h, various solid fuels processed

3. Red Lake High School, Red Lake, Minnesota, 3.93 GJ/h, wood chips to produce low pressure steam

SUKUP MANUFACTURING CO.

ADDRESS	P.O. Box 677 Sheffield, IA 50475
PHONE	515-892-4222
TELEX	62025126
FAX	
CONTACT	Mr. Bob Sanders, Product Director
ACTIVITY	Manufacturer
CANADIAN REPRESENTATIVES	Phair Farm & Building Dresden, Ontario
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (BIOMASTER FURNACE)

The Biomaster Furnace manufactured by the Sukup Manufacturing Co. is a single chamber combustor fitted with an integral air-to-air heat exchanger. The resulting hot clean air has been used in various agricultural drying and heating applications. The Biomaster Furnace is available in two models (1.6 GJ/h and 3.6 GJ/h). Fuel is introduced into the refractory-lined furnace by a feed screw. A simple control system is provided which automatically controls feed rate and furnace temperature. An air mixing damper which allows dilution cooling of the hot gas can be provided as an option.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust, wood chips, husklage, rice hulls, sunflower hulls	
	Size	- minimum	
		- maximum	
		- recommended	
	Moisture	- maximum	25% m.c. grain biomass
		- recommended	

Auxiliary Fuel:	Propane for startup and fuels >25% m.c.
Electricity Requirements:	28 KW
Output Capacity:	1.6 - 3.6 GJ/h
Energy Product:	Hot gas
Fuel Input Rate:	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Optional packages available including storage bins, conveyors etc. Auger feed is standard.
Emission Control:	None
Ash Handling:	Manual
Control Instrumentation:	

D. SYSTEM COST

Basic Combustion	- Smallest	$ 35,500
	- Largest	
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

SUPERBURN SYSTEMS LTD.

ADDRESS	200 - 409 Granville Street Vancouver, B.C. V6C 1T2
PHONE	604-682-2642
TELEX	04 51122
FAX	604-669-1034
CONTACT	Mr. Bert Put, Manager, Sales and Marketing
ACTIVITY	Manufacturer, supplier
CANADIAN REPRESENTATIVES	As above
REPRESENTATIVES	
PARENT COMPANIES	As above

A. SYSTEM DESCRIPTION (SUPERBURN REVOLVING FLUIDIZED BED INCINERATOR)

Superburn Systems Ltd. supplies a patented fluidized bed incinerator system through its Vancouver Head Office and European subsidiaries, Superburn UK and Superburn Germany. System sizes are available with outputs from 3.2 GJ/h to 27 GJ/h based on utilization of municipal solid waste fuel and production of steam.

The Superburn Revolving Fluidized Bed incinerator is rectangular in shape having a fluidizing air box divided into three zones and deflector plates on the sides of the chamber. Fluidizing air is introduced at a greater rate in the outer zones producing higher perimeter fluidizing intensity compared to the centre zone. The perimeter flow is deflected towards the centre of the chamber and a revolving bed is produced. This system has been thoroughly demonstrated for energy recovery from municipal and industrial wastes in the Orient and Western Europe. Its suitability for other fuel types has been expressed for fuels having a calorific value greater than 5.8 MJ/kg. Fuels of lesser quality require the use of auxiliary fuel to sustain combustion.

Standard fuel handling equipment provided with the system include a shear shredder for oversized material, feed bin and twin screw feeder. Custom design of alternate storage and handling systems can be provided to meet the user's requirements. Depending on the fuel characteristics an ash handling system can be provided. The heavy non-combustibles and ash are carried to the perimeter of the furnace where they are removed along with some fluidizing sand. Sand is separated from this discharge and recycled. Pollution abatement equipment supplied with the system also depends on the fuel burned and might include electrostatic precipitation and acid gas reduction through the introduction of dry limestone and NO_x reduction catalyst.

Energy recovery systems supplied with the incinerator can be one of two types. On the larger systems an integral waste heat boiler can be supplied to raise steam. With smaller incinerators a heat exchanger can be provided to recover energy by circulation of hot water or hot oil.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, MSW, agricultural waste, industrial waste	
	Size	- minimum	None
		- maximum	None with shredder
		- recommended	4 in^2
	Moisture	- maximum	
		- recommended	
Auxiliary Fuel:		Auxiliary fuel is required for start-up and for fuels below 1400 kcal/kg	
Electricity Requirements:		Variable, depending on size	
Output Capacity:			
Energy Product:		Hot water, hot oil, steam	
Fuel Input Rate:		15 t/d - 120 t/d	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Fuel storage and handling can be supplied according to customer needs
Emission Control:	Emission controls can be provided according to specific requirements; may include electrostatic precipitator, NO_x reduction catalyst
Ash Handling:	Ash handling system can be provided depending on fuel burned

Control Instrumentation: Best Available Control Technology (BACT) will be provided according to customer needs.

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

None

THERMACO ENGINEERING SERVICES LTD.

Address:	P.O. Box 569 Streetsville, Ontario L5M 2C1
Phone:	(416) 671-0650
Telex:	
Fax:	(416) 679-0264
Contact:	Mr. B. F. Tessler, President
Activity:	Suppliers of Energy From Waste Incinerators
Canadian Representatives:	
Representatives:	
Parent Companies:	Pyrox Industries Inc. 5085 Rideau St. Anlienne - Lorette, Quebec G2E 5P9

A. SYSTEM DESCRIPTION

Thermaco supplies Pyrotek controlled-air solid waste incinerator systems in a size range of roughly 0.5 to 18 GJ/h. Bulk or rough shredded municipal, industrial or pathological wastes are batch loaded into the refractory lined first-stage chamber which is operated under starved-air conditions for fuel pyrolysis. Off-gases pass to the secondary refractory-lined combustion chamber through a turbulent mixing zone where additional air is added to complete burnout at high-temperature. Auxiliary fuel burners (gas or oil) are used for ignition and temperature control. Ash is removed manually. Options include a semiautomatic hydraulic ram feeder and automatic wet quench ash removal system.

Incinerators are fitted with Pyrox heat recovery units including hot water or steam boilers and hot oil or air heat exchangers. Emission control systems (wet scrubber and baghouse) can be supplied when required and Isotherm refractory-lined stacks are available.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- MSW, agricultural waste
	Size	- minimum - maximum - recommended 10.16 x 10.16 x 10.16 cm
	Moisture	- maximum 50% - recommended
Auxiliary Fuel:		Natural gas or light oil
Electricity Requirements:		Varies - 550 VAC/three phase/60 Hz
Output Capacity:		Sizes Available - 0.11 - 10.6 GJ/h
Energy Product:		Hot gas, hot water, hot oil, steam
Fuel Input:		22.7 kg/h - 2.72 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Ram load feeder, hydraulic ram to push waste to primary chamber
Emission Control:	Baghouse, wet scrubber
Ash Handling:	Automatic ash removal with water quench
Control Instrumentation:	Complete control, oxygen control, process controllers

D. SYSTEM COST

Basic Combustion	- Smallest	$ 80 K
	- Largest	$ 1300 K
Turnkey System	- Smallest	$ 120 K
	- Largest	$ 2600 K

E. INSTALLATIONS

1. Sudbury Memorial Hospital, Sudbury, Ontario
2. South Rock Falls Hospital, South Rock, Ontario
3. Public Works Canada, Ottawa, Ontario

THOMAS INDUSTRIAL SALES LTD.

ADDRESS:	P.O. Box 1032 Fredericton, New Brunswick E3B 5C2
PHONE:	506-453-1183
TELEX:	
FAX:	
CONTACT:	Mr. G. (Gordon) Thomas, President
ACTIVITY:	Suppliers of Volcano Wood-Fired Boilers
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	

A. SYSTEM DESCRIPTION

Volcano manufacturers four lines of biofuel combustors: an RS series for dry particulate wood fuels in several sizes from about 7 - 14 GJ/h, an A or TF series for wet wood fuels in sizes of roughly 10 - 100 GJ/h, an SM series for unprocessed wood wastes up to 65% MC, and the B&S system for municipal solid wastes or other coarse biofuel.

RS Series

Designed to operate on wood fuels of less than 20% MC the 3-pass horizontal fire-tube boilers (Scotch Marine configuration) are available for steam or hot water. Typically an above ground silo with bottom auger unloader supplies the wood fuel to a hopper, rotary valve and blower for pneumatic delivery to the top of the boiler. The suspended fuel is injected in a swirl pattern and is partially burned in suspension with larger particles completing combustion on a fixed grate. Forced undergrate primary air is provided while exhaust gases pass to a multiclone dust collector fitted with a pneumatic flyash re-injection system.

A or TF Series

The A model with water-tube steam boiler and the TF model with thermal fluid heater utilize Wellons Cell combustion chambers. Single or multiple refractory lined chambers with water cooled fixed grates employ pole burning of coarse wood-waste fuels. Preheated combustion air is supplied below the grates and above the pile. Ashes are periodically removed manually from the grates.

Exhaust gases from the boiler pass to a multiclone dust collector, the air preheater, then to an ID fan and the stack. An automated fuel feed system typically includes a drag-chain conveyor from storage to metering bin with live-bottom unloader, a screw auger conveyor and drop chutes feeding the combustion cells.

SM Series

Designed for unprocessed woodwaste up to 65% MC they employ a sloping grate section plus a moving foot grate. An adjacent burnout chamber is situated below a steam boiler section or thermal fluid heater unit.

B&S System

Designed for MSW (or other bulk biofuels) their systems cover a range of roughly 10 - 130 GJ/h and employ either an air-cooled rotating step grate or water cooled sliding step grate.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, and agricultural wastes	
	Size	- minimum	
		- maximum	
		- recommended	
	Moisture	- maximum	65%
		- recommended	

Auxiliary Fuel:

Electricity Requirements: Depends on size

Output Capacity: Sizes Available - 5.3 GJ/h - almost any size

Energy Product: Hot water, hot oil, steam

Fuel Input: 0.274 t/h - almost any feedrate

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling: Storage bin, hopper and pneumatic or mechanical screw feeding system

Emission Control: Cyclone dust collection

Ash Handling: Automatic

Control Instrumentation: Fully automatic control

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

List not provided

TILLEY MFG LTD.

Address: Arthurette, RR#2
N.B.
EOJ 1CO

Phone: (506) 273-2462

Telex:

Fax:

Contact: Mr. K. (Kevin) Goodine, Owner

Activity: Manufacturers of Wood Chip Burners

Canadian Representatives: Michaud Equipment Ltd.
Gervais Farms Inc.

Representatives:

Parent Companies:

A. SYSTEM DESCRIPTION

The Tilley Wood Chip Burner is manufactured in three sizes, 0.3, 0.4 and 0.7 GJ/h, for retrofitting of forced-air furnaces or hot water boilers. Wet or air-dry particulate wood fuels of less than 25 mm particle size can be utilized.

A storage hopper with fuel agitator and inclined screw unloader drops the fuel into the pre-heater combustion chamber. A flat pin-hole grate is used with upper reciprocating and lower stationary steel plates. Ash is manually removed via a cleanout at the base of the refractory-lined duct that transfers the combustion gases to the furnace/boiler.

Thermostatically controlled underfire primary air and manually set secondary air are provided in the natural draft system. A forced-air flow through an air-jacket provides cooling to the steel walled combustion chamber. An overheat activated water quench is provided to prevent burnback while fuel flow is governed by a fire sensor and overfill limit switch.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust, wood chips	
	Size	- minimum	0.4 cm
		- maximum	2.5 cm
		- recommended	2.5 cm
	Moisture	- maximum	50%
		- recommended	20 - 35%

Auxiliary Fuel:	
Electricity Requirements:	20 Amp
Output Capacity:	Sizes Available - 0.18 - 0.42 GJ/h
Energy Product:	
Fuel Input Rate:	13.0 - 30.5 kg/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Hopper bin with auger feed.
Emission Control:	Clean burning
Ash Handling:	Very little ash build up with proper control settings move ash to exterior
Control Instrumentation:	Simplified control panel for stocking and cleaning operation.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 6.6K
	- Largest	$ 12.75K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

List not provided

TRENT INDUSTRIES INC.

ADDRESS	P.O. Box 3156, Stn. "B" Saint John, N.B. E2M 4X8
PHONE	(506) 633-6066
TELEX	
FAX	
CONTACT	Mr. R. (Richard) Franey, President
ACTIVITY	Manufacturers of complete turnkey combustion systems
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION

Trent Industries manufacture, install and commission turn-key biofuel energy systems in the range of 2.1 to 36 GJ/h. Wet or air-dry particulate fuels can be utilized including chips, hog fuel, pellets, mill residues or agricultural wastes.

Fuel handling is typically done using a below grade silo with a hydraulic scrape unloader and screw auger transfer conveyors. An undergrate stoker delivers fuel to a refractory-lined combustion chamber with forced draft under- and overfire air. Final burnout occurs in an integral heat exchanger with energy output as steam, hot water, hot oil or warm air. Ash is automatically removed to external containers while particulate control is achieved by a multiclone dust collector or electrostatic precipitator. An ID fan passes exhaust gases to an insulated stack. Programmable controllers provide fully automated, unattended operation.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - hog fuel, sawdust, wood chips, agricultural waste

Size	- minimum	
	- maximum	10.0 cm
	- recommended	5.0 cm
Moisture	- maximum	65%
	- recommended	35 - 50%

Auxiliary Fuel:	Back-up oil or gas burners available, systems normally only use biomass.
Electricity Requirements:	Vary with plant size
Output Capacity:	Sizes Available - 1.37 - 23.21 GJ/h
Energy Product:	Hot gas, hot water, hot oil, and steam
Fuel Input:	0.385 - 5.2 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	In ground fuel silo with rake reclaim. Heavy screw conveyor transport systems.
Emission Control:	Multiple cyclone fly ash collectors or electrostatic precipitators, custom designed stacks for correct exit velocities.
Ash Handling:	Fully designed automatic or semi-automatic, automatic grate shakers, moving grates, augers move ash to exterior container.
Control Instrumentation:	Custom process control with programmable controllers, pressure, temperature, flame, oxygen, etc. Designed to operate unattended.

D. SYSTEM COST

Basic Combustion	- Smallest
	- Largest
Turnkey System	- Smallest
	- Largest

E. INSTALLATIONS

1. Hugh John Flemming Forestry Complex, Fredericton, N.B.
2. Peacock Nurseries, Saint John, N.B.
3. Nova Scotia Nautical Institute, Port Hawkesbury, Nova Scotia.

TRICIL LIMITED (Consumat)

ADDRESS	Main Office: 89 Queensway West, 8th Floor Mississauga, Ontario L5B 2V2 Branch Plant: P.O. Box 2518 Charlottetown, PEI C1A 8C2
PHONE	(416) 270-8280 (Toronto) (902) 892-1085 (Charlottetown)
TELEX	
FAX	
CONTACTS	Ms. Beth Burton-Hunter, Corporate Communications (Toronto) Mr. S. (Steen) Flint, Branch Manager (Charlottetown)
ACTIVITY	Suppliers of Energy from Waste Systems
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (Consumat)

TRICIL Ltd. can supply Energy-from-Waste plants which incorporate the Consumat line of controlled-air incinerators, whose development began over 20 years ago and now number over 85 installations. The modular plants (0.2 - 48 GJ/h) are suitable for industrial installations or small municipalities.

Municipal solid waste is moved from the tipping floor to the feed hopper by front-end loader. An automatic hydraulic loader passes the fuel into the first (gasification) chamber where transfer rams move the fuel bed slowly through the chamber. Air in the primary chamber is limited to less than that required for complete combustion. The combustible gases that are generated, pass to a second chamber where excess secondary air is supplied to ensure complete combustion at elevated temperatures.

Exhaust gas can be vented via a dump stack or pass to the heat exchanger module for production of hot water or steam. Ash and non-combustibles pass from the primary chamber to a wet sump and are conveyed to a closed bottom container for haul to landfill. A microprocessor-based fully-automated control system ensures complete combustion in an efficient and environmentally acceptable manner.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- MSW	
	Size	- minimum	none
		- maximum	
		- recommended	
	Moisture	- maximum	
		- recommended	
Auxiliary Fuel:			
Output Capacity:		Sizes Available - 47.5 GJ/h	
Energy Product:		Hot gas, hot water, hot oil, steam, electricity	
Fuel Input:		98.0 t/d	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Provisions can be made to suit application
Emission Control:	Supplied to meet defined requirements
Ash Handling:	Build to requirements
Control Instrumentation:	Build to requirements

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

1. SWRU - Energy from Waste Plant, Hamilton, Ont.
2. Charlottetown, Prince Edward Island, 108 t/d, produce 150 psig steam
3. Hazardous Waste Plant, Sarnia, Ont.

TSI TRINTEK SYSTEMS (ONTARIO) INC.

ADDRESS	10 Planchet Road, Unit 19 Concord, Ontario L4K 2C8
PHONE	(416) 669-9542
TELEX	06-964665
FAX	
CONTACT	Mr. R. (Robert) Lawson, President
ACTIVITY	Manufacture and Supply Controlled Air Modular Incinerators
CANADIAN REPRESENTATIVES	
REPRESENTATIVES	
PARENT COMPANIES	

A. SYSTEM DESCRIPTION (Basic)

TSI holds the rights to manufacture and market the Basic Environmental Engineering line of controlled-air modular incinerators (0.4 - 59 GJ/h) which have been on the market for over 15 years, with over 60 operating installations.

This system can utilize a variety of biofuels, including wood wastes (hog fuel, sawdust, chips), logs, agricultural wastes, MSW and sewage sludge, and commercial and industrial wastes such as asphalt scrap or rubber tires. The fuel delivery system depends on the type of waste and the system size, with options including: pit and overhead crane, tipping floor and mobile loader, or storage silos plus conveyors. Fuel is moved from the feed hopper into the combustor by an electromagnetic ram.

The primary combustion chamber features a membrane water-wall furnace above a sectional, stepped fire brick hearth with air jets along the steps. The suspended hearth sections are pulsed intermittently by an air-bag arrangement, and the resulting shuffling effect moves the burning wastes through the chamber. Ash is removed from the wet ash pit by an automated scoop.

Combustion gases from the primary chamber are directed through parallel, refractory-lined reburn tunnels with fossil fuel burners and staged secondary air. A hot gas output can be supplied for direct drying applications or a waste-heat boiler included to supply hot water, hot oil or steam. A hydrated lime and fabric filter system can be supplied, if required, for emission control. The combustion system is controlled by a solid-state microprocessor with provision for remote monitoring and troubleshooting.

A. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- hog fuel, sawdust, wood chips, small log, MSW, argricultural waste, large logs, rubber tires	
	Size	- minimum	none
		- maximum	1.22 x 1.524 x 0.6096 m
		- recommended	
	Moisture	- maximum	50%
		- recommended	
Auxiliary Fuel:		Natural gas or oil for start up	
Electricity Requirement:		575 VAC/60 Hz/3 phase	
Output Capacity:		Sizes Available - 0.4 - 58.8 GJ/h	
Energy Product:		Hot water, hot oil, steam, hot gas	
Fuel Input:		0.045 - 5.44 t/h	

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Smaller systems using wood are equipped with a silo, larger systems use tipping floor with loader or a pit with overhead crane.
Emission Control:	Units operate within Ontario Standards for wood burning applications. On MSW systems a hydrated lime conditioner reactor with a fabric filter is provided.
Ash Handling:	The ash is cooled in a wet ash pit and then removed automatically with a clam.
Control Instrumentation:	System completely automated using a microprocessor solid state control system.

D. SYSTEM COST

Basic Combustion	- Smallest	$ 75 K
	- Largest	$ 2750 K
Turnkey System	- Smallest	
	- Largest	

E. INSTALLATIONS

1. St. John's University, Collegeville, Minnesota
2. Over 60 units installed since 1972 burning rubber tires, municipal sludge, municipal solid waste, wood wastes and industrial or commercial wastes.

VOLCANO INC.

ADDRESS: 4300 Beaudry
St. Hyacinthe, Quebec
J2S 8A5

PHONE: 514-774-5326

TELEX:

FAX:

CONTACT: M. Normand Lapierre, Vice President

ACTIVITY: Suppliers of Volcano Wood-Fired Boilers

CANADIAN REPRESENTATIVES:

REPRESENTATIVES:

PARENT COMPANIES:

A. SYSTEM DESCRIPTION

Volcano manufactures four lines of biofuel combustions: an RS series for dry particulate wood fuels in several sizes from about 7 - 14 GJ/h, an A or TF series for wet wood fuels in sizes of roughly 10 - 100 GJ/h, an SM series for unprocessed wood wastes up to 65% MC, and the B&S system for municipal solid wastes or other coarse biofuel.

RS Series

Designed to operate on wood fuels of less than 20% MC the 3-pass horizontal fire-tube boilers (Scotch Marine configuration) are available for steam or hot water. Typically an above ground silo with bottom auger unloader supplies the wood fuel to a hopper, rotary valve and blower for pneumatic delivery to the top of the boiler. The suspended fuel is injected in a swirl pattern and is partially burned in suspension with larger particles completing combustion on a fixed grate. Forced undergrate primary air is provided while exhaust gases pass to a multiclone dust collector fitted with a pneumatic flyash re-injection system.

A or TF Series

The A model with water-tube steam boiler and the TF model with thermal fluid heater utilize Wellons Cell combustion chambers. Single or multiple refractory lined chambers with water cooled fixed grates employ pole burning of coarse woodwaste fuels. Preheated combustion air is supplied below the grates and above the pile. Ashes are periodically removed manually from the grates.

Exhaust gases from the boiler pass to a multiclone dust collector, the air preheater, then to an ID fan and the stack. An automated fuel feed system typically includes a drag-chain conveyor from storage to metering bin with live-bottom unloader, a screw auger conveyor and drop chutes feeding the combustion cells.

SM Series

Designed for unprocessed woodwaste up to 65% MC they employ a sloping grate section plus a moving foot grate. An adjacent burnout chamber is situated below a steam boiler section or thermal fluid heater unit.

B&S System

Designed for MSW (or other bulk biofuels) their systems cover a range of roughly 10 - 130 GJ/h and employ either an air-cooled rotating step grate or water cooled sliding step grate.

B. SYSTEM SPECIFICATIONS

Fuels Specification:	Type	- hog fuel, sawdust, wood chips, and agricultural wastes	
	Size	- minimum	
		- maximum	
		- recommended	
	Moisture	- maximum	65%
		- recommended	

Auxiliary Fuel:	
Electricity Requirements:	Depends on size
Output Capacity:	Sizes Available - 5.3 GJ/h and up
Energy Product:	Hot water, hot oil, steam
Fuel Input Rate:	0.274 t/h - almost any feedrate

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Storage bin, hopper and pneumatic or mechanical screw feeding system

Emission Control: Cyclone dust collection

Ash Handling: Automatic

Control Instrumentation: Fully automatic control

D. SYSTEM COST

Basic Combustion - Smallest
- Largest

Turnkey System - Smallest
- Largest

E. INSTALLATIONS

List not provided

WAYCOT SYSTEMS LTD.

ADDRESS:	Royal Bank Plaza North Tower, Suite 770 P.O. Box 95 Toronto, Ontario M5J 2J2
PHONE:	416-363-1135
TELEX:	
FAX:	416-363-8078
CONTACT:	Mr. G.M. Webster, President
ACTIVITY:	Manufacturers of Cogeneration Systems
CANADIAN REPRESENTATIVES:	
REPRESENTATIVES:	
PARENT COMPANIES:	

A. SYSTEM DESCRIPTION (Cogeneration System)

WAYCOT cogeneration systems range in size from small industrial to large industrial (21 - 105 GJ/h), and incorporate from one to four burners.

The Waycot system is a two-chamber unit, with combustion being initiated in the Turbulator and concluding in a refractory lined combustion chamber. In the Turbulator section of the system hot combustion air is mixed with the fuel. The combustion air is preheated by pulling it over the walls of the refractory lined burner. The gas exit temperature of the system can be run as high as 1400 C. The hot combustion gases exiting the burner can be used in a number of processes including rotary driers, dry kilns, heat exchangers and steam boilers.

Potential fuels include sawdust, bark, hog lumber, sander dust, digester sludge, rice hulls, straw, city refuse derived fuel (RDF) and many others.

Full automation is incorporated throughout the system including ash removal.

B. SYSTEM SPECIFICATIONS

Fuel Specification:	Type	- sawdust and wood chips	
	Size	- minimum	none
		- maximum	1.0 cm
		- recommended	
	Moisture	- maximum	40%
		- recommended	25%

Auxiliary Fuel:	Oil or gas for pilot light
Electricity Requirements:	22 kW
Output Capacity:	Sizes Available - 21.0 GJ/h
Energy Product:	Hot gas
Fuel Input Rate:	1.52 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:	Silo - conveyor (screw or air)
Emission Control:	Depending on fuel - none or baghouse
Ash Handling:	Preferably dry but can be slag
Control Instrumentation:	Fully automatic to give constant temperature effluent gases

D. SYSTEM COST

Basic Combustion	- Smallest	$ 350 K
	- Largest	$ 1500 K
Turnkey System	- Smallest	
	Largest	

E. INSTALLATIONS

List not provided

WESTINGHOUSE CANADA INC.

ADDRESS: 280 University Ave.
Suite 303
Toronto, Ontario
M5G 1V2

PHONE: 416-595-9550

TELEX:

FAX:

CONTACT: Mr R.J. Bolton, Sales Engineer, Utility Sales

ACTIVITY: Manufacturer - Suppliers of Waste Energy Systems

CANADIAN REPRESENTATIVES:

REPRESENTATIVES:

PARENT COMPANIES: Westinghouse Electric Corporation
Pittsburgh, PA

A. SYSTEM DESCRIPTION

WESTINGHOUSE is the manufacturer and supplier of the Westinghouse O'Connor waste-to-energy system. The system can handle a wide range of waste materials such as MSW, sewage sludge, wood waste, and residual oil.

The size ranges from small industrial to large industrial (21 - 190 GJ/h). The heart of the system is the water-cooled, rotary barrel combustor. It is constructed of alternating longitudinal water tubes and flat perforated steel plates. The perforations provide controlled distribution of the combustion air, while the water-cooled walls remove some of the sensible heat of the waste material, which protects the barrel from overheating. Waste is fed directly from the receiving area into the upper end of the combustor using a ram feeding system. The combustor is slightly inclined to allow the waste material to tumble down the length of the rotating barrel. The waste will dry and progressively burn as it reaches the lower end of the barrel. The ash dropping out of the lower end of the barrel is almost totally incinerated. Any unburned material is more completely combusted in an afterburning grate.

The combustion gases transmit heat to water tubes and the water-wall boiler to produce steam. Exhaust gases exiting the boiler pass through quality control equipment which allows for the removal of any particulates and acid gases.

B. SYSTEM SPECIFICATIONS

Fuel Specification: Type - hog fuel, sawdust, wood chips, small log, MSW, agricultural waste

Size
- minimum
- maximum 0.91 m
- recommended limited by feed chute size

Moisture
- maximum 65%
- recommended 20 - 65%

Auxiliary Fuel:

Electricity Requirements:

Output Capacity: Sizes Available - 21 - 190 GJ/h

Energy Product: Steam

Fuel Input Rate: 1.2 - 10.4 t/h

C. ANCILLARY EQUIPMENT

Fuel Storage and Handling:

Emission Control: Particulate removal by electrostatic precipitator or filter baghouse - acid gas clean up with scrubber

Ash Handling: Drag chain conveyor

Control Instrumentation: Programmable - processor system

D. SYSTEM COST

Basic Combustion
- Smallest
- Largest

Turnkey System
- Smallest
- Largest

E. INSTALLATIONS

1. Bay County (Panama City), Florida
2. Dutchess County (Poughkeepsie), New York

C. Consultant's Data Base

This listing is intended to complement the Catalogue of Small Scale Combustors for Biomass Fuel. The consultants listed here have claimed experience with biomass or other related energy systems. The list of consultants contacted for information was derived mainly from the directories of the provincial consulting engineering associations and the Association of Consulting Engineers of Canada (ACEC). All of these associations are listed in Table III-3 as they may be of use to the reader when searching for a consultant.

Not all consultants listed in this directory have handled projects specifically dealing with small scale combustors using solid biomass fuel. Many consultants however, have experience in related areas such as alternative energy, energy economics and cost studies, boiler or incinerator installations and associated equipment design and/or selection, etc. Still others have experience with larger scale projects such as hog fuel boilers, solid waste incinerators, thermal generating systems, etc. This broadening of the scope was intended to enhance the listing.

All consultants were contacted by phone or through questionnaires sent out in the mail. Sample questionnaires are attached in Appendix I. Most consultants replied with appropriate responses which are included in this listing. Those firms contacted, but not included in this listing, either chose not to be listed or did not respond to our request for information.

An index of consultants organized alphabetically by Province is given in Table III-4. A complete listing of the responses from consultants follows the index.

Many consultants have branch offices or affiliates in more than one province. A reasonable effort was made to include these as complete entries or at least as partial entries with reference made to the original consultant contacted. Any omission of branch offices or affiliates is unintentional.

In general, consultants with more than one office within a province were listed only by the head office or office claiming related expertise. On occasion, however, one or more branch office within a province was also listed. In these cases, the individual branch office was also contacted either by phone or by mailed questionnaire.

TABLE III-3 CONSULTING ENGINEERING ASSOCIATION OFFICES

Association of Consulting Engineers of Canada
130, rue Albert Street
Suite 616
Ottawa, Ontario
K1P 5G4

Telephone: (613) 236-0569
FAX : (613) 236-6193
Telex : 053-4830

H.R. Pinault, P.Eng.
Managing Director

Consulting Engineers of British Columbia
601 - 890 West Pender Street
Vancouver, B.C.
V6C 1K4

Telephone: (604) 687-2811
FAX : (604) 687-1327
Telex : 04-51592

Consulting Engineers of Alberta
Suite 1410 Oxford Tower
10235 - 101 Street
Edmonton, Alberta
T5J 3G1

Telephone: (403) 420-6066
FAX : (403) 425-4623

Harold V. Page, P.Eng.
Managing Director

- continued -

TABLE III-3 CONSULTING ENGINEERING ASSOCIATION OFFICES

Association of Consulting Engineers of Saskatchewan
2123C Broad Street
Regina, Saskatcehwan
S4P 1Y6

Telephone: (306) 359-3338

Association of Consulting Engineers of Manitoba Inc.
4 Donald Street South
Winnipeg, Manitoba
R3L 2T7

Telephone: (204) 475-7774

Consulting Engineers of Ontario
86 Overlea Boulevard
Suite 403
Toronto, Ontario
M4H 1C6

Telephone: (416) 425-8027

Association des ingenieurs-conseils du Quebec
2050, rue Mansfield
Bureau 600
Montreal, Quebec
H3A 1Y9

Telephone: (514) 288-2032

Consulting Engineers of New Brunswick
P.O. Box 1630
Mall centre Ville
Shediac, New Brunswick
E0A 3G0

Telephone: (506) 532-2425

- continued -

TABLE III-3 CONSULTING ENGINEERING ASSOCIATION OFFICES

Nova Scotia Consulting Engineers Association
P.O. Box 613, Station M
Halifax, Nova Scotia
B3J 2R7

Telephone: (902) 429-4786

Consulting Engineers of Yukon
3167 - 3rd Avenue
Whitehorse, Yukon
Y1A 1G4

(403) 668-3068

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ALBERTA

COMPANY NAME	Acres International Limited		
ADDRESS	5th Floor 10201 Southport Road S.W. Calgary, Alberta T2W 4X9	TELEPHONE FAX TELEX	(403) 253-9161 (403) 255-2444 03-825582
CONTACT NAME	Mr. T. Waters		
DESCRIPTION OF SERVICES	See B.C.		
RECENT EXAMPLES	See B.C.		

COMPANY NAME	APSCO Engineering Ltd.		
ADDRESS	P.O. Box 270 Crimona, Alberta TOM ORO	TELEPHONE FAX TELEX	(403) 637-3955
CONTACT NAME	J. Dueck		
DESCRIPTION OF SERVICES	Engineering for and manufacturing of small combustor processes to produce hot water, low and high pressure steam, or thermal oil using any wood or burnable material.		
RECENT EXAMPLES	Designed and installed boilers for Wilkman Windows, Winnipeg; Alberta Pilot, Airdrie; Pelly Crossing, Yukon; Kraft Tech Furniture, Steinbeck.		

COMPANY NAME	Associated Engineering Alberta Ltd.		
ADDRESS	13220 St. Albert Trail Edmonton, Alberta T5L 4W1	TELEPHONE FAX TELEX	(403) 451-7666 (403) 454-7698
CONTACT NAME	R. Cawley		
DESCRIPTION OF SERVICES	Complete design service to commissioning, selection and specifications of equipment.		
RECENT EXAMPLES	- Solid fuel fired heating plant for Union Oil. - Coal fired/stokered fired heating systems for Slave Lake Elementary School. - Cordwood fired heating plant for Old Crow School in the Yukon.		

COMPANY NAME	CH2M HILL Engineering Ltd.		
ADDRESS	11th Floor 815 - 8th Avenue, S.W. Calgary, Alberta T2P 3P2	TELEPHONE FAX TELEX	(403) 230-0100 (403) 237-7715
CONTACT NAME	G. Giesbrecht		
DESCRIPTION OF SERVICES	Full range of services in all disciplines.		
RECENT EXAMPLES	- Wood fired boiler for industrial client in California. - Refuse derived fuel project for Westinghouse. - Incinerator operating guidelines for the Province of Ontario.		

COMPANY NAME	Cheriton Engineering Inc.		
ADDRESS	10160 - 112 Street Edmonton, Alberta T5K 2L6	TELEPHONE FAX TELEX	(403) 421-4440 (403) 421-4300 03741432
CONTACT NAME	D.K. Knutson		
DESCRIPTION OF SERVICES	Economic and feasibility studies, energy audits and boiler testing.		
RECENT EXAMPLES	- Feasibility study of switching to solid fuel (coal) at Fort Saskatchewan Jail and Spy Hill Correction Centre. - Selected the boiler and other components for University of Alberta power plant.		

COMPANY NAME	Hardy BBT Limited		
ADDRESS	219 - 18th Street Calgary, Alberta T2E 6J5	TELEPHONE FAX TELEX	(403) 248-4331 (403) 248-2188
CONTACT NAME	W. Younkin		
DESCRIPTION OF SERVICES			
RECENT EXAMPLES	- Cold Lake project: determination of Btu available from clear-cutting.		

COMPANY NAME	Hycarb Engineering Ltd.		
ADDRESS	Suite # 1720	TELEPHONE	(403) 266-7086
	144 - 4th Avenue, S.W.	FAX	(403) 266-7086
	Calgary, Alberta	TELEX	03825717
	T2P 3N4		
CONTACT NAME	G.R. Crandall		
DESCRIPTION OF SERVICES	Energy balances, economics, conversion costs.		
RECENT EXAMPLES	Preliminary feasibility cogeneration study in Ontario.		

COMPANY NAME	Kasten, Eadie Consulting Engineering Ltd.		
ADDRESS	# 102, 14315 - 118 Avenue	TELEPHONE	(403) 451-9101
	Edmonton, Alberta	FAX	(403) 452-9083
	T5L 4S6	TELEX	
CONTACT NAME	W. Eadie		
DESCRIPTION OF SERVICES	General process engineering with particular emphasis on the petroleum industry.		
RECENT EXAMPLES	Thermal and mechanical design of heat exchangers for Syncrude and Suncor at Fort McMurray and for the heavy oil upgrader at Lloydmister.		

COMPANY NAME	Keen Engineering Co. Ltd.		
ADDRESS	103 - 10235 - 124 Street	TELEPHONE	(403) 482-6921
	Edmonton, Alberta	FAX	(403) 482-1236
	T5N 1P9	TELEX	0372966
CONTACT NAME	H.M. Hleck		
DESCRIPTION OF SERVICES	Design of steam generation systems, complete range of energy services.		
RECENT EXAMPLES			

COMPANY NAME	L M & M Engineering Ltd.		
ADDRESS	400, 10735 - 107th Avenue	TELEPHONE	(403) 424-8364
	Edmonton, Alberta	FAX	(403) 428-6967
	T5H 0W6	TELEX	0372966
CONTACT NAME	M. Mitchell		
DESCRIPTION OF SERVICES	Multidisciplinary engineering, specifications and economics.		
RECENT EXAMPLES	- Used peat to produce a low Btu fuel and steam in Wisconsin and South Carolina - wood sawdust was also used in Wisconsin. - Thermal fluid steam generation and heating system using hog fuel in Grand Prairie.		

COMPANY NAME	Monenco Consultants Ltd.		
ADDRESS	400 Monenco Place 801 - 6th Avenue S.W. Calgary, Alberta T2P 3W3	TELEPHONE FAX TELEX	(403) 298-4170 (403) 298-4125 03-822636
CONTACT NAME			
DESCRIPTION OF SERVICES	All engineering disciplines - evaluations, design, project supervision.		
RECENT EXAMPLES			

COMPANY NAME	Recol Engineering Ltd.		
ADDRESS	5108 Varscliff Road, N.W. Calgary, Alberta T3A 0G3	TELEPHONE FAX TELEX	(403) 288-5274
CONTACT NAME	R. Ritter		
DESCRIPTION OF SERVICES	Feasibility studies and system design of thermal waste destruction systems.		
RECENT EXAMPLES	- Feasibility studies for small scale municipal waste incinerators with energy recovery. - Municipal and hazardous waste incinerators for Alberta government and Chemsecurities.		

COMPANY NAME	Safronek Pomeroy & Associates Ltd.		
ADDRESS	# 302, 239 - 10th Avenue, S.E. Calgary, Alberta T2G 0V9	TELEPHONE FAX TELEX	(403) 233-0070
CONTACT NAME	E. Safronek		
DESCRIPTION OF SERVICES	HVAC, mechanical/electrical engineering.		
RECENT EXAMPLES	- Waste heat recovery for the Foothills Hospital incinerator project. - Boiler installations for Grand Prairie Hospital and Lethbridge Courthouse.		

COMPANY NAME	Suncord Engineering Ltd.		
ADDRESS	# 307, 9006 - 132 Avenue Edmonton, Alberta T5E 0Y2	TELEPHONE FAX TELEX	(403) 473-2111 (403) 473-2112
CONTACT NAME	J. Stewart		
DESCRIPTION OF SERVICES	Studies, evaluations and new designs of boiler plants. General engineering services in the mechanical field. Inspection services.		
RECENT EXAMPLES	- Heat recovery studies from incineration at three Alberta locations. - Oil fired boiler at a hospital in Camrose. - Economics of waste heat recovery balances. - Heat recovery study at Inuvik.		

COMPANY NAME	UMA Engineering Ltd.		
ADDRESS	17007 - 107th Avenue	TELEPHONE	(403) 483-7722
	Edmonton, Alberta	FAX	(403) 483-2163
	T5S 1G3	TELEX	
CONTACT NAME	V. Lessoway		
DESCRIPTION OF SERVICES	HVAC mechanical, prefeasibility studies, design.		
RECENT EXAMPLES	See B.C.		

COMPANY NAME	Western Industrial Consultants Inc.		
ADDRESS	201 - 11710 Kingsway Avenue	TELEPHONE	(403) 452-5196
	Edmonton, Alberta	FAX	(403) 451-2846
	T5G 0X5	TELEX	
CONTACT NAME	W.J. Francl		
DESCRIPTION OF SERVICES	Feasibility studies, energy balances and economics.		
RECENT EXAMPLES	- Design and project management for incinerators in Yellowknife. - Boiler design for a drywall plant in Edmonton.		

COMPANY NAME	Wiebe Forest Engineering Ltd.		
ADDRESS	604 - 24A Street, N.W.	TELEPHONE	(403) 283-6658
	Calgary, Alberta	FAX	(403) 283-6270
	T2N 2S4	TELEX	
CONTACT NAME	M. Kadziolka or J.C. Wiebe		
DESCRIPTION OF SERVICES	Mechanical and electrical in HVAC, energy studies, energy analysis, feasibility studies and design for commercial and industrial clients.		
RECENT EXAMPLES	- Wood generators as alternative source of energy for Cardston School. - Recovery of waste heat from pool for building heating at Radium Aquacourt.		

COMPANY NAME	A.D. Williams		
ADDRESS	# 106, 4999 - 98th Avenue	TELEPHONE	(403) 468-2512
	Edmonton, Alberta	FAX	(403) 469-2864
	T6B 2X3	TELEX	
CONTACT NAME	A.D. Williams, G.W. Devine		
DESCRIPTION OF SERVICES	Structural and mechanical from predesign to construction.		
RECENT EXAMPLES	- Expansion of the heating and power plant at University of Alberta. - Central heating and power plant at Inuvik. - Study of going to decentralized plants for power at Frobisher Bay.		

BRITISH COLUMBIA

COMPANY NAME	Acres International Limited
ADDRESS	4th Floor, 845 Cambie Street Vancouver, B.C. V6B 2P4
TELEPHONE	(604) 683-9141
FAX	(604) 683-9148
TELEX	04-55128
CONTACT NAME	D.L.R. Cronin
DESCRIPTION OF SERVICES	Planning, feasibility, engineering, design.
RECENT EXAMPLES	- Assessed the various alternative sources of energy for NWT communities including coal, biomass and waste heat recovery for Energy, Mines and Resources. - Conceptual study of a power generating plant fired with waste wood and fuel oil in Ocean Falls. - Steam and power plant extensions in Kitimat.

COMPANY NAME	Canadian Resourcecon (1983) Ltd.
ADDRESS	Suite 1950 505 Burrard Street Vancouver, B.C. V7X 1M5
TELEPHONE	(604) 682-8691
FAX	(604) 662-3329
TELEX	
CONTACT NAME	P. Midgley
DESCRIPTION OF SERVICES	Economic and technical assessments and studies.
RECENT EXAMPLES	- Wood waste-fueled, indirectly fired, gas turbine cogeneration plant for sawmill applications. - Wood waste utilization study in Chiloe wood fired generation plant. - Analysis of the future importance of biomass in the B.C. energy scheme.

COMPANY NAME Dayton & Knight Ltd.

ADDRESS
626 Clyde Avenue
P.O. Box 91247
West Vancouver, B.C.
V7T 3N9

TELEPHONE (604) 922-3255
FAX (604) 922-3255
Local 12

CONTACT NAME A. Berzins

DESCRIPTION OF SERVICES Prefeasibility assessments, value engineering, preliminary engineering and pre-design to detailed design.

RECENT EXAMPLES Solid waste to energy studies for the Regional District of Nanaimo, B.C., Central Kootenay Regional District and others.

COMPANY NAME E.H. Hanson & Associates Ltd.

ADDRESS
Suite No. 4, 7550 River Road
Delta, B.C.
V4G 1C8

TELEPHONE (604) 946-0111
FAX (604) 946-6359
TELEX

CONTACT NAME E.H. Hanson or G. Huculak

DESCRIPTION OF SERVICES Feasibility studies on resource recovery projects. Engineering design, tender documents and project management of energy and resource recovery projects.

RECENT EXAMPLES E.H. Hanson Manufacturing produces a 10 - 40 GJ/h combustor of pelletized fuels.

COMPANY NAME	Keen Engineering Co. Ltd.		
ADDRESS	214 - 545 Clyde Avenue West Vancouver, B.C. V7T 1C5	TELEPHONE FAX TELEX	(604) 926-3207 (604) 922-0056
CONTACT NAME	N.P. Rempel		
DESCRIPTION OF SERVICES	Design of steam generation systems, complete range of energy services.		
RECENT EXAMPLES	- Wood chip boiler at Pelly Crossing. - Kamloops boiler plant using solid waste.		

COMPANY NAME	B.H. Levelton & Associates Ltd.		
ADDRESS	8805 Osler Street Vancouver, B.C. V6P 4G1	TELEPHONE FAX TELEX	(604) 266-1411 (604) 266-0130 04-352848
CONTACT NAME	W.C. Edwards		
DESCRIPTION OF SERVICES	Technical and economic feasibility studies, conceptual design, equipment selection, environmental assessments.		
RECENT EXAMPLES	- A major study entitled "A Comparative Assessment of Forest Bioass Conversion to Energy Forms" was done for Energy, Mines and Resources to assist potential users of biomass energy. - A feasibility study for a wood-fired steam engine/generator set for electricity generation at Fort Ware, B.C. was completed for Indian and Northern Affairs.		

COMPANY NAME	Novatec Consultants Inc.		
ADDRESS	300 - 40 Powell Street	TELEPHONE	(604) 682-8777
	Vancouver, B.C.	FAX	(604) 682-3521
	V6A 1E7	TELEX	
CONTACT NAME	W.F. Hyslop		
DESCRIPTION OF SERVICES	Feasibility studies, design, selection of equipment, operational assistance.		
RECENT EXAMPLES	- Evaluation of municipal sludge disposal alternatives for B.C. - High strength industrial waste treatment options.		

COMPANY NAME	Phillips Barratt Kaiser Engineering Ltd.		
ADDRESS	# 200 - 2150 West Broadway	TELEPHONE	(604) 736-5421
	Vancouver, B.C.	FAX	(604) 736-1519
	V6K 4L9	TELEX	04-508660
CONTACT NAME	C.C. Rush		
DESCRIPTION OF SERVICES	A full range of services is provided in civil, structural, mechanical and electrical engineering design. Includes investigations, studies, specifications and contract documents; construction supervision, inspection and management; costing, estimating and scheduling; and purchasing.		
RECENT EXAMPLES	- Cogeneration feasibility studies for the Yukon government. - Waste wood evaluations and subsequent cogeneration studies for several B.C. lumber companies. - Evaluation of energy systems.		

COMPANY NAME	Sandwell Swan Wooster		
ADDRESS	700 - 1190 Hornby Street Vancouver, B.C. V6Z 2H6	TELEPHONE FAX TELEX	(604) 684-9311 (604) 688-5913 04-51275
CONTACT NAME	B. Beveridge		
DESCRIPTION OF SERVICES	Complete engineering and project management for energy generation projects including planning, feasibility studies, detailed design, construction and erection supervision, project management, commissioning and training, inspection and rehabilitation.		
RECENT EXAMPLES	- Design of a waste wood and coal-fired steam and power plant for Blount Int., Tennessee. - Modifications to the wood waste-fired boiler for Western Pulp Limited Partnership in Port Alice. - Detailed design of 400,000 lb/h hog fuel fired boiler.		

COMPANY NAME	H.A. Simons Ltd.		
ADDRESS	425 Carrall Street Vancouver, B.C. V6B 2J6	TELEPHONE FAX TELEX	(604) 664-4656 (604) 669-9516 (604) 683-1510 04-51150
CONTACT NAME	J.S. Elliott		
DESCRIPTION OF SERVICES	Prefeasibility and feasibility studies, equipment specifications, selection, purchase recommendations, specifications for piping, mechanical, electrical, control systems and structural.		
RECENT EXAMPLES	H.A. Simons Ltd. is fully experienced with all aspects of thermal energy generation and conversion primarily in the pulp and paper and wood products industry. - Worked on waste wood and coal fired boilers. - Studies to assess biomass to energy conversion.		

COMPANY NAME	D.W. Thomson Consultants Ltd.		
ADDRESS	1690 West Broadway Vancouver, B.C. V6J 1X9	TELEPHONE FAX TELEX	(604) 731-4921 (604) 738-4420
CONTACT NAME	P.E. Marmion		
DESCRIPTION OF SERVICES	Evaluation of economics and design of heating systems.		
RECENT EXAMPLES	- Firetube boiler using wood chips at the Law Court building in Whitehorse. - Selected a fluidized bed boiler and designed the heating system using coal, wood chips and paper as fuel for Yukon College in Whitehorse.		

COMPANY NAME	UMA Engineering Ltd.		
ADDRESS	3030 Gilmore Diversion Burnaby, B.C. V5G 3B4	TELEPHONE FAX TELEX	(604) 438-5311 (604) 438-5319 EOS; 21; UMA 002
CONTACT NAME	S.S. Strilchuk		
DESCRIPTION OF SERVICES	Prefeasibility studies, design.		
RECENT EXAMPLES	Costs and cost effectiveness of energy recovery from solid waste at Cenoka Ind., Kelowna.		

MANITOBA

COMPANY NAME	Acres International Limited		
ADDRESS	Sixth Floor	TELEPHONE	(204) 786-8751
	500 Portage Avenue	FAX	(204) 786-2242
	Winnipeg, Manitoba	TELEX	07-55281
	R3C 3Y8		
CONTACT NAME	Mr. W. McKay		
DESCRIPTION OF SERVICES	See B.C.		
RECENT EXAMPLES	See B.C.		

COMPANY NAME	Action Consulting Engineers Inc.		
ADDRESS	Four Donald Street South	TELEPHONE	(204) 284-8551
	Winnipeg, Manitoba	FAX	(204) 474-0356
	R3L 2T7	TELEX	
CONTACT NAME	D.B. McKibbin		
DESCRIPTION OF SERVICES	Standard mechanical consulting for all types of buildings and some industries.		
RECENT EXAMPLES	- Installed small boilers to cut power consumption at United Churches in Winnipeg. - Winnipeg Airport steam plant conversion for Transport Canada.		

COMPANY NAME	G.H. Currie & Associates Ltd.		
ADDRESS	107 - 62 Hargrave Street Winnipeg, Manitoba R3C 1N1	TELEPHONE FAX TELEX	(204) 943-3457 (204) 956-4200
CONTACT NAME	G.H. Currie		
DESCRIPTION OF SERVICES	Design of mechanical systems for commercial, institutional and industrial buildings, energy studies and management.		
RECENT EXAMPLES	- Cost benefit studies of converting fuels for an upgrade of the steam plant at Brandon University. - Review of a waste oil heater for approval under Manitoba statutes.		

COMPANY NAME	MCW Consultants Ltd.		
ADDRESS	600 - 352 Donald Street Winnipeg, Manitoba R3B 2H8	TELEPHONE FAX TELEX	(204) 943-8475 (204) 943-1582
CONTACT NAME	J. Lear		
DESCRIPTION OF SERVICES	Mechanical from conceptual through site supervision.		
RECENT EXAMPLES	- Boiler replacement for Canadian Forces Base. - Replaced steam distribution system for Canadian Forces Base, Winnipeg. - Replaced heating system for the Winnipeg Federal Building (steam to hot water). - Proposal for heat recovery from refuse incineration for Trizak Corp.		

COMPANY NAME	MacLaren Engineers Inc.		
ADDRESS	Suite 640, 5 Donald Street	TELEPHONE	(204) 477-6650
	Winnipeg, Manitoba	FAX	(204) 474-2864
	R3L 2T4	TELEX	
CONTACT NAME	J.M. KcKernan		
DESCRIPTION OF SERVICES	Full range of engineering services including quantity studies, dispersion modelling, life cycle costing.		
RECENT EXAMPLES	- Landfill and incineration study for municipal waste disposal, Winnipeg. - Solid waste management in Riding Mountain for Parks Canada. - Municipal solid waste burning plant.		

COMPANY NAME	UMA Engineering Ltd.		
ADDRESS	1479 Buffalo Place	TELEPHONE	(204) 284-0580
	Winnipeg, Manitoba	FAX	(204) 475-3646
	R3T 1L7	TELEX	07-57562
CONTACT NAME	R. McLean		
DESCRIPTION OF SERVICES	Full range of services from preliminary to construction management (affiliate) in most engineering disciplines.		
RECENT EXAMPLES	- Solid fuel fired boiler selection for CN Rail. - Specified boiler for the waste water division of the City of Winnipeg plant.		

COMPANY NAME Wardrop Engineering Inc.

ADDRESS

77 Main Street
Winnipeg, Manitoba
R3C 3H1

TELEPHONE	(204) 956-0980
FAX	(204) 957-5389
TELEX	07-57487

CONTACT NAME W.D. Christie

DESCRIPTION OF SERVICES Studies, prototype development, project management, design, construction services and engineering analysis.

RECENT EXAMPLES

- Energy from waste evaluation for the City of Winnipeg.
- Solid waste management study including energy recovery.
- Design of wood refuse boiler at Nova Scotia Pulp Ltd.
- Heating plant modification assessment at Churchill.

NEW BRUNSWICK

COMPANY NAME	ADI Limited		
ADDRESS	1133 Regent Street P.O. Box 44, Station "A" Fredericton, New Brunswick E3B 4Y2	TELEPHONE FAX TELEX	(506) 452-9000 (506) 459-3954
CONTACT NAME	A. Steeves		
DESCRIPTION OF SERVICES	Broad based consulting services.		
RECENT EXAMPLES	- Wood fired heating boilers for the University of New Brunswick and the Regional Hospital. - Study to install wood heater at Thunder Bay School in Edmonston, New Brunswick.		

COMPANY NAME	Eastcan Consultants Ltd.		
ADDRESS	175 Henri Dunant Street Moncton, New Brunswick E1E 1E4	TELEPHONE FAX TELEX	(506) 857-8880 (506) 859-8393
CONTACT NAME	M.A. MacLellan, P.Eng.		
DESCRIPTION OF SERVICES	Mechanical and electrical consultants - HVAC, PL, boiler plants, fire protection, building electrical systems.		
RECENT EXAMPLES	- Glycol heat recovery loops, heat recovery refrigeration systems, heat recovery from laundry water and exhaust air at Moncton Hospital.		

COMPANY NAME	Enerplan Consultants Ltd.		
ADDRESS	86 Botsford Street Moncton, New Brunswick E1C 4X3	TELEPHONE FAX TELEX	(506) 858-1300 (506) 858-1906
CONTACT NAME	K. Bavis		
DESCRIPTION OF SERVICES	Mechanical engineering design and energy management; total energy retrofits, biomass and other alternative energy systems.		
RECENT EXAMPLES	- Boiler plant retrofit at the University of New Brunswick, St. John Campus. - Numerous boiler retrofits at schools.		

COMPANY NAME	D.S. Mackay & Associates Ltd.		
ADDRESS	14 Tilley Street P.O. Box 340 Hampton, New Brunswick E0G 1Z0	TELEPHONE FAX TELEX	(506) 832-5536 (506) 832-3755
CONTACT NAME	Donald S. Mackay, P.Eng.		
DESCRIPTION OF SERVICES	Engineering consultants		
RECENT EXAMPLES	- Wood heating plant study, Stanley Regional School, School District No. 9, Stanley, N.B. - Wood heating plant study, Perth Elementary School, Perth, N.B. - Wood heating plant, Belleisle Regional High School, District No. 19, Springfield, N.B.		

COMPANY NAME	Neill and Gunter Limited		
ADDRESS	191 Prospect Street	TELEPHONE	(506) 452-7000
	P.O. Box 713	FAX	(506) 452-0112
	Fredericton, New Brunswick	TELEX	014-46238
	E3B 5B4		
CONTACT NAME	S.G. Landry		
DESCRIPTION OF SERVICES	Consulting and design engineering services, project management, detailed design, installation drawings and site services.		
RECENT EXAMPLES	- Waferboard plants - wet hog fuel boilers for plant and process heating. - Heating roundhouse - maintenance shops		

COMPANY NAME	SMA Engineering Ltd.		
ADDRESS	50 Cameron Street	TELEPHONE	(506) 857-8708
	Moncton, New Brunswick	FAX	(506) 857-8989
	E1C 5Y4	TELEX	
CONTACT NAME	L. MacDonald		
DESCRIPTION OF SERVICES	Feasibility studies, reports, field surveys, design, preparation of contract documents, construction inspection, supervision and contract administration.		
RECENT EXAMPLES	- Energy conservation studies at several hospitals in New Brunswick. - Waste heat recovery at Edmonston Regional Hospital: wood waste boilers and laundry waste - water heat recovery.		

NEWFOUNDLAND

COMPANY NAME Fenco Newfoundland Ltd.

ADDRESS
189 Water Street
St. Johns, Newfoundland
A1C 5J2

TELEPHONE (709) 754-1480
FAX (709) 726-1145
TELEX 016-4936

CONTACT NAME H. Gray

DESCRIPTION OF SERVICES See Nova Scotia - Fenco Shawinigan Engineering Ltd.

RECENT EXAMPLES

COMPANY NAME Northland Associates

ADDRESS
P.O. Box 1734
St. Johns, Newfoundland

TELEPHONE (709) 576-6820
FAX
TELEX

CONTACT NAME P. Duffet

DESCRIPTION OF SERVICES Project managers performing inventory resource analysis, prefeasibility and feasibility studies and costings.

RECENT EXAMPLES

- Peat inventory work for the government of Newfoundland.
- Operational analysis for Southern Avalon Peat Development.
- Operational layout for Burin Peninsula Development Association.

COMPANY NAME	Provincial Consultants Ltd.		
ADDRESS	3 Maxse Street	TELEPHONE	(709) 726-6634
	St. Johns, Newfoundland	FAX	(709) 739-0904
	A1C 2S6	TELEX	
CONTACT NAME	D. Stewart		
DESCRIPTION OF SERVICES	Energy surveys, energy management strategies, alternate fuel assessment, renewable energy assessments, retrofit design for mechanical, electrical and building envelope systems.		
RECENT EXAMPLES	- Potential to displace oil with peat for Provincial Dept. of Environment. - Lifecycle cost analysis for St. Anthony Nursing Home.		

COMPANY NAME	Shawmont Newfoundland Ltd.		
ADDRESS	P.O. Box 9600	TELEPHONE	(709) 754-0250
	St. Johns, Newfoundland	FAX	(709) 739-6823
	A1A 3C1	TELEX	
CONTACT NAME	A. Peach		
DESCRIPTION OF SERVICES	Complete range of services for energy management such as energy audits, recommendations, design services, project management and monitoring of retrofits.		
RECENT EXAMPLES	- Wood-fired space heating systems at Gander and Cornerbrook, Newfoundland Hospitals. - Feasibility and conceptual studies of the merits of installing wood burners. - Industrial and commercial energy audits.		

COMPANY NAME	Terpstra Engineering Ltd.		
ADDRESS	386 Hamilton River Road	TELEPHONE	(709) 896-8052
	P.O. Box 10, Station A	FAX	(709) 896-8857
	Goose Bay, Newfoundland	TELEX	
	AOP 1SO		
CONTACT NAME	J. Terpstra		
DESCRIPTION OF SERVICES	Energy audits, retrofits, infrared scans.		
RECENT EXAMPLES	- Energy audits of various industries in Newfoundland under the Energy Boss Program (EMR). - First R2000 home in the province.		

NOVA SCOTIA

COMPANY NAME	Brodie and Associates/Engineering		
ADDRESS	# 1 Pleasant View Drive Onsolow, Nova Scotia B2N 5V2	TELEPHONE FAX TELEX	(902) 895-7565
CONTACT NAME	D. Brodie		
DESCRIPTION OF SERVICES	HVAC design and control systems - energy and environmentally related. Feasibility studies of district heating or wood fuel conversions.		
RECENT EXAMPLES	- Feasibility studies on wood-fired boilers, Aberdeen Hospital in New Glasgow; Universite St. Anne, Churchpoint, Nova Scotia.		

COMPANY NAME	CBCL Limited		
ADDRESS	1496 Lower Water Street P.O. Box 606 Halifax, Nova Scotia B3J 2R7	TELEPHONE FAX TELEX	(902) 421-7241 (902) 423-3938
CONTACT NAME	J. Gould-Thorpe, P.Eng. P. Meridew D.J.B. Watts, P.Eng.		
DESCRIPTION OF SERVICES	Consulting engineers - full range of advisory design and inspection services for civil, structural, mechanical and electrical.		
RECENT EXAMPLES	- PEI Hospital/Home - Hernewood Rural School - Westisle Rural High School - Bridgewater N.S. Dawson Memorial Hospital - DND Cornwallis N.S. (Training Base)		

COMPANY NAME	Dumac Energy		
ADDRESS	6155 North Street Suite 305 Halifax, Nova Scotia B3K 5R3	TELEPHONE FAX TELEX	(902) 429-2505 (902) 453-6820
CONTACT NAME	D. Dumaresq		
DESCRIPTION OF SERVICES	Engineering design and project administration.		
RECENT EXAMPLES	- Engineering design and project administration for a 13 GJ/hr wood chip boiler installation including mechanical, electrical and civil for the Nova Scotia Department of Government Services.		

COMPANY NAME	Energy Engineering		
ADDRESS	116 Cottage Road Sydney, Nova Scotia B1P 2E1	TELEPHONE FAX TELEX	(902) 562-6544 (902) 564-9158
CONTACT NAME	K. Chisin		
DESCRIPTION OF SERVICES	Energy related engineering such as biomass energy systems, waste heat recapture.		
RECENT EXAMPLES	- Designed wood heating systems (small scale approximately 0.1 GJ/h).		

COMPANY NAME	Enerplan Consultants (N.S.) Ltd.		
ADDRESS	33 Ochterloney Street Dartmouth, Nova Scotia B2Y 4P5	TELEPHONE FAX TELEX	(902) 464-1255 (902) 464-1134
CONTACT NAME	S. Tweedie		
DESCRIPTION OF SERVICES	See New Brunswick		
RECENT EXAMPLES			

COMPANY NAME	Fenco Shawinigan Engineering Ltd.		
ADDRESS	701 - 1959 Upper Water Street Halifax, Nova Scotia B3J 3N2	TELEPHONE FAX TELEX	(902) 421-3200 (902) 425-4464
CONTACT NAME	B. King		
DESCRIPTION OF SERVICES	Prefeasibility, detailed design, construction management, and will work with supplier to provide turnkey services.		
RECENT EXAMPLES	- 5 MW wood chip-fired power plant for the Newfoundland Power Utility. - Design of heating plant at Halifax International Airport. - Use of a coal-water fuel for Cape Breton Development Corp.		

COMPANY NAME Henderson Engineering Consultants Ltd.

ADDRESS
Suite 302 Bedford Tower
1496 Bedford Highway
Bedford, Nova Scotia
B4A 1E5

TELEPHONE (902) 835-6533
FAX (902) 835-8786
TELEX

CONTACT NAME B. Henry

DESCRIPTION OF SERVICES HVAC, fire protection, plumbing, energy studies.

RECENT EXAMPLES

- Wood chip fired boiler for middle Musquodoboits Dept. of Lands and Forests, Nova Scotia.
- 400 hp high pressure steam plant for a Nova Scotia hotel.

COMPANY NAME C.J. MacLellan and Associates Ltd.

ADDRESS
205 Hawthorne Street
Antigonish, Nova Scotia
B2G 1B6

TELEPHONE (902) 863-1220
FAX (902) 863-3225
TELEX

CONTACT NAME L.D. MacLellan

DESCRIPTION OF SERVICES Cost consultants doing energy balances and energy audits.

RECENT EXAMPLES

- Provided preliminary cost estimates for a wood chip boiler at St. Martha's Hospital.
- Local retrofits of school boilers.

COMPANY NAME	Monenco Maritimes Ltd.		
ADDRESS	Suite 500 Barrington Tower Scotia Square Halifax, Nova Scotia B3J 2A8	TELEPHONE FAX TELEX	(902) 429-8110 (902) 425-8295
CONTACT NAME	K. Tonn		
DESCRIPTION OF SERVICES	Mechanical, electrical and structural engineering for industrial and commercial type projects.		
RECENT EXAMPLES	- Wood-fired boilers for James Paton Memorial and Westing Memorial Hospitals in Newfoundland. - Feasibility studies for energy from wood.		

COMPANY NAME	Porter Dillon Ltd.		
ADDRESS	2651 Dutch Village Road Suite 202 Halifax, Nova Scotia B3L 4G5	TELEPHONE FAX TELEX	(902) 453-1115 (902) 454-6886
CONTACT NAME	G. Isenor		
DESCRIPTION OF SERVICES	Environmental engineering group providing services in the private and public sectors including municipal engineering, waste management, urban planning and industrial waste treatment, evaluation of potential.		
RECENT EXAMPLES	- Waste to energy sites for Dept. of Mines and Energy, Nova Scotia. - Site specific feasibility study of waste to energy at Kings County municipality.		

COMPANY NAME	Whitmen Benn and Associates Limited		
ADDRESS	Suite 1001 Barrington Tower	TELEPHONE	(902) 420-8900
	Scotia Square	FAX	(902) 420-8949
	Halifax, Nova Scotia	TELEX	
	B3J 2A8		
CONTACT NAME	R. Mills		
DESCRIPTION OF SERVICES	Multidisciplinary firm providing services in prefeasibility, feasibility, HVAC, site supervision, design, selection of equipment and turnkey projects.		
RECENT EXAMPLES	- Feasibility study of using waste wood products for cogeneration in Oxford, Nova Scotia. - Dual fuel boiler (oil and wood) for Wellington Elementary School. - Feasibility study of a briquette manufacturing plant.		

ONTARIO

COMPANY NAME Acres International Limited

ADDRESS
480 University Avenue
Toronto, Ontario
M5G 1V2

TELEPHONE (416) 595-2114
FAX (416) 595-2127
TELEX 06-217815

CONTACT NAME Robert Gudgeon

DESCRIPTION OF SERVICES Feasibility studies, engineering design, economic studies, construction supervision.

RECENT EXAMPLES

- Feasibility study for a wood-fired boiler system in Clarenville and Gander District Technical Schools, Newfoundland.
- Biomass utilization study concerning the economic and technical aspects of wood, peat and wood gasification fuel systems to provide steam for electrical generation.
- Feasibility study and design of a wood waste-fired boiler to replace a 21 GJ/h oil-fired boiler and provide 1034 KPa process steam.

COMPANY NAME H.H. Angus and Associates

ADDRESS
1127 Leslie Street
Don Mills, Ontario
M3C 2J6

TELEPHONE (416) 443-8200
FAX (416) 443-8290
TELEX

CONTACT NAME Mr. Peter Willings

DESCRIPTION OF SERVICES Consulting engineers for commercial and institutional buildings specializing in heating, ventilation, air conditioning, plumbing, fire protection, electrical.

RECENT EXAMPLES

- Waste from hospital fires a high pressure boiler to produce steam for space heating and hospital use.

COMPANY NAME
Canviro Consultants
A Division of CH2M Hill Engineering Ltd.

ADDRESS
180 King Street South
Waterloo, Ontario
N2J 1P8

TELEPHONE (519) 579-3500
FAX (519) 579-8986
TELEX

CONTACT NAME
Mr. Ray Stickney

DESCRIPTION OF SERVICES
Design of boiler and cogeneration facilities for operation of biogas from anaerobic digestion and landfill applications.

RECENT EXAMPLES

- Pittens Farms Ltd. - electrical cogeneration system on biogas 40 kW complete with connection to the grid.
- Selves Farms Ltd. - electrical cogeneration system on biogas 90 kW complete with connection to the grid.
- Linden Lee Farms - electrical cogeneration system on biogas 40 kW complete with connection to the grid.

COMPANY NAME
Conestoga-Rovers & Associates Ltd.

ADDRESS
651 Colby Drive
Waterloo, Ontario
N2V 1C2

TELEPHONE (519) 884-0510
FAX (519) 884-0525
TELEX

CONTACT NAME
Mr. Gary Kestle

DESCRIPTION OF SERVICES
Civil, environmental and municipal engineering; specialty is toxic and hazardous waste management.

RECENT EXAMPLES

- Possible utilization of landfill methane gas as an alternate energy source - municipality of metropolitan Toronto, Regional Municipality of Waterloo.
- Incineration and heat recovery from contaminated gas - Cincinnati, Ohio.
- Landfill gas sites - Port Mann, B.C.; Hamilton, Ontario; Wausau, Wisconsin.

COMPANY NAME	Consultec Ltd.		
ADDRESS	4180 Dundas Street West Toronto, Ontario M8X 1X8	TELEPHONE FAX TELEX	(416) 236-2426 (416) 236-3677 06-984797
CONTACT NAME	Mr. Tom Ireland		
DESCRIPTION OF SERVICES	Civil, mechanical and structural engineering, environmental studies and assessments, process engineering and equipment selection.		
RECENT EXAMPLES	- Feasibility, economic modelling, process design and equipment selection of wood chip-fired 9 MW boiler, Cochrane, Ontario. - Feasibiltiy studies on T.D.F. (Tire Derived Fuel); Louisville, Kentucky.		

COMPANY NAME	Dick Engineering Inc.		
ADDRESS	250 The Esplanade Suite 308 Toronto, Ontario M5A 1J2	TELEPHONE FAX TELEX	(416) 862-0977 (416) 756-4998 06-23007
CONTACT NAME	Mr. Bill Dick		
DESCRIPTION OF SERVICES	Civil, mechanical, structural engineering, feasibility studies, construction supervision.		
RECENT EXAMPLES	- 5.0 GJ/h wood residue-fired hot water boiler and fuel preparation/handling system; Grenville Christian College, Brockville, Ontario. - Feasibility study of a fluidized bed gasifier, 120 GJ/h, wood residue fired; Lakehead University, Ontario. - Feasibility studies of wood residue-fired hot water boilers; Smith Falls, Kemptville, Ontario.		

COMPANY NAME Ensyn Engineering Associates Inc.

ADDRESS
2610 Del Zotto Avenue
R.R. 5
Gloucester, Ontario
K1G 3N3

TELEPHONE (613) 822-1835
FAX
TELEX

CONTACT NAME D. Huffman

DESCRIPTION OF SERVICES Consulting services in renewable energy technologies including combustion and gasification of biomass fuels.

RECENT EXAMPLES

- Testing and assessment of the SUKUP agricultural residue combustor (3.2 GJ/h).
- Preparation of a catalogue of small-scale biomass combustors available in Canada.
- Preparation of detailed data base information document on Canadian bioenergy installations (including small combustors).

COMPANY NAME Gore & Storrie Limited

ADDRESS
1670 Bay View Avenue
Toronto, Ontario
M4G 3C2

TELEPHONE (416) 485-7715
FAX (416) 485-0014
TELEX 0623283

CONTACT NAME Mr. Neil Perkins

DESCRIPTION OF SERVICES Consulting services for municipal and industrial clients, services include engineering for solid waste, hazardous waste, waste water and water treatment facilities including solid waste and sewage sludge incinerators and waste heat boilers.

RECENT EXAMPLES

- Lakeview - Water Pollution Control Plant - 2 fluid bed sludge incinerators with waste heat boilers.
- Metropolitan Toronto - Main Treatment Plant - 6 multiple hearth incinerators with waste heat boilers.

COMPANY NAME Hatch Associates Ltd.

ADDRESS
554 Main Street East
Hamilton, Ontario
L8M 1J3

TELEPHONE (416) 526-7220
FAX (416) 526-7766
TELEX

CONTACT NAME Mr. Henry Ichiyen

DESCRIPTION OF SERVICES Civil, mechanical, structural, environmental, process engineers; construction and process management.

RECENT EXAMPLES

- 350 tonnes/day domestic solid waste-fired steam boiler system that generates 3 MW electricity.

COMPANY NAME Hatch Associates Ltd.

ADDRESS
21 St. Clair Avenue East
Toronto, Ontario
M4T 1L9

TELEPHONE (416) 962-6350
FAX (416) 962-0622
TELEX 065-24315

CONTACT NAME Dr. Chris Twigge-Molecey

DESCRIPTION OF SERVICES Engineering consulting; specializing in heavy industrial, metallurgical, transportation, pulp and paper, automotive, also management consulting.

RECENT EXAMPLES

- Rebuilt SWRU (Solid Waste Reduction Unit), a 600 tonne/h solid waste incinerator that generates steam for cogeneration, Hamilton, Ontario.

- Demonstration Unit: wood chip gasifier that produced fuel gas that was flared.

COMPANY NAME	Heathwood Engineering Products Ltd.		
ADDRESS	29 Duncan Avenue North	**TELEPHONE**	(705) 567-3295
	P.O. Box 190	**FAX**	(705) 568-8545
	Kirkland Lake, Ontario	**TELEX**	067-82512
CONTACT NAME	Mr. Jim Rorrison		
DESCRIPTION OF SERVICES	General engineering specializing in the mining and forest forest products industry.		
RECENT EXAMPLES	- Currently developing a prototype of plasma arc furnace to burn wet or dry wood residue, to provide hot air for commercial installations. - Feasibility study for wood chip-fired boiler system to provide space heating at Energreen, Raymore, Ontario.		

COMPANY NAME	JAD Engineering Ltd.		
ADDRESS	80 Birmingham Street	**TELEPHONE**	(416) 255-0666
	Toronto, Ontario	**FAX**	
	M8V 3W6	**TELEX**	
CONTACT NAME	Mr. Bruce Raymond		
DESCRIPTION OF SERVICES	Mechanical and electrical building services engineering.		
RECENT EXAMPLES	- Gas from municipal liquid waste fires a package (4.0 GJ/h) hot water boiler at the Welland Water Pollution Control Plant.		

COMPANY NAME	**Jellicoe Resource Associates**		
ADDRESS	**4580 Fieldgate Drive, Unit 15**	**TELEPHONE**	(416) 238-3201
	Mississauga, Ontario		(416) 238-6188
	L4W 4K4	**FAX**	(416) 625-6437
		TELEX	
CONTACT NAME	Mr. Dan Jellicoe		
DESCRIPTION OF SERVICES	Feasibility, engineering and construction of wood biomass energy systems; specializing in remote central heating systems; small scale biomass-fired cogeneration systems that produce electricity.		
RECENT EXAMPLES	- 10.5 GJ/h wood residue-fired steam boiler that provides hot water for a district heating system, Kingsway College, Oshawa. - 8.4 GJ/h particle board-fired boiler provides steam to heat 3 acres of greenhouses at Foothills Greenhouses, Holland Marsh. - 5.3 GJ/h wood residue-fired low-pressure boiler provides steam for process and space heating at Peacock Lumber, Oshawa.		

COMPANY NAME W.P. London and Associates Limited (The SNC Group)

ADDRESS
4056 Dorchester Road
P.O. Box 1025
Niagara Falls, Ontario
L2E 6V9

TELEPHONE (416) 356-1543
FAX (416) 356-8559
TELEX 061-5171

CONTACT NAME Mr. Dudley Abraham

DESCRIPTION OF SERVICES General consulting engineers, turnkey services.

RECENT EXAMPLES

- Currently engineering a 400 tonne/day, municipal solid waste, high pressure steam boiler to generate 8 MW electricity for sale to Ontario Hydro; Region of Peel, Brampton.

- 400 tonne/day municipal solid waste-fired boiler produces 1200 kW electricity and 33 tonne/h of steam for process requirements, Hartford County, Maryland, USA.

- Wood waste-fired boilers provide 72,500 kg high pressure steam/h for process requirements; Georgia Pacific, N.Y., USA.

- Hogged wood waste/oil dual-fuel boiler provides 170,000 kg steam/h for process requirements at Kimberly-Clark, Ontario.

- Feasibility study for waste wood-fired cogeneration system (30 MW electricity and 209,000 kg steam/h) for the Northern Michigan Electrical Co-op.

COMPANY NAME	MacLaren Engineers/Lavalin Inc.		
ADDRESS	Place de Ville, Tower B Suite 500, 112 Kent Street Ottawa, Ontario K1P 5P2	TELEPHONE FAX TELEX	(613) 235-4325 (613) 235-8390 053-3570
CONTACT NAME	Mr. Rick Leduc		
DESCRIPTION OF SERVICES	Civil, electrical, mechanical, structural, environmental engineering and project management.		
RECENT EXAMPLES	- Feasibility study of coffee bean-fired low pressure boilers that produce steam for space heating, Nestle Plant, Smith Falls. - Feasibility study of methane (from sludge) fired high pressure 550 KPa boilers to provide steam for process and space heating, Green Creek Pollution Control Centre, Ottawa, Ontario.		

COMPANY NAME	MacLaren Engineers/Lavalin Inc.		
ADDRESS	320 Adelaide Street South London, Ontario N5Z 3L2	TELEPHONE FAX TELEX	(519) 686-5711
CONTACT NAME	Mr. John Myatt		
DESCRIPTION OF SERVICES	Consulting engineering services, civil engineering: waste water, water supply; solid waste; air pollution control; industrial engineering; energy conservation.		
RECENT EXAMPLES	- Municipal sewage sludge-fired, 3000 tonnes dry solids/h, Dorr-Oliver fluidized bed incinerator (15% of sludge is newspaper pulp, added as a dewatering agent); hot gases are fed through a heat exchanger to produce hot water for space heating.		

COMPANY NAME MacLaren Engineers/Lavalin Inc.

ADDRESS
2235 Sheppard Avenue East
Willowdale, Ontario
M2J 5A6

TELEPHONE	(416) 756-4919
FAX	(416) 756-4998
TELEX	06-23765

CONTACT NAME Mr. Bob Hansberger

DESCRIPTION OF SERVICES Consulting engineering services; civil engineering: waste water engineering, water supply, solid waste, air pollution control; industrial engineering, energy conservation.

RECENT EXAMPLES

- Biogas from anaerobic, fixed film reactor feeds an engine/generator set and waste heat boiler to produce 15 kW electricity and hot water.
- Energy from waste, 300 tonnes/day municipal refuse-fired boiler produces 9000 kg/h steam, and 5 MW electricity at Tag-Hansen Greenhouses, Leamington, Ontario.
- 1 tonne/h municipal refuse fires a 0.4 GJ/h hot water boiler to supply hot water for a 330 unit apartment complex; University Towers Apartment building, York University, Toronto.
- 126 GJ/h solid waste-fired incinerator feeds a cogeneration system proving 5 MW electricity and steam for heating and cooling (absorption chillers); Victoria Hospital, London, Ontario.
- 1.1 GJ/h refuse-fired incinerator provides hot water for heating and use at the Cadillac Fairview CHMC Canwell Project, Toronto, Ontario.

COMPANY NAME	B.H. Martin Consultants Limited		
ADDRESS	1 Pine Street South Suite 202 Timmins, Ontario P4N 2J9	TELEPHONE FAX TELEX	(705) 264-9413 (705) 267-2725
CONTACT NAME	Mr. Barry Martin		
DESCRIPTION OF SERVICES	General engineering consulting services, specializing in fuel preparation and handling systems.		
RECENT EXAMPLES	- Designed bioshell manufacturing plants in Hearst, Iroquois (Ontario) and Lac Magantic (Quebec). Wood waste is fed through a hog, dryer, hammermill and pelletizer to produce 300 tonnes/day.		

COMPANY NAME	The Mitchell Partnership Limited		
ADDRESS	59 Mobile Drive Toronto, Ontario M4A 1H8	TELEPHONE FAX TELEX	(416) 751-3733 (416) 759-0465
CONTACT NAME	Mr. Jim Lawden		
DESCRIPTION OF SERVICES	Mechanical engineering consultants to the building construction field.		
RECENT EXAMPLES	- Feasibility study for a wood chip-fired steam boiler system; steam drives a generator for electricity and waste heat recovery. - Feasibility study for a fluidized bed gasifier, 100 tonnes/day of solid waste produces steam for cogeneration of electricity and heat. - Feasibility study for a municipal wood waste-fired steam boiler that provides steam for cogeneration of electricity and heat.		

COMPANY NAME	Monenco Consultants Ltd.		
ADDRESS	155 Rexdale Blvd. Rexdale, Ontario M9W 5Z8	TELEPHONE FAX TELEX	(416) 743-3456 (416) 743-2926 06-989419
CONTACT NAME	G.W. Mankinen		
DESCRIPTION OF SERVICES	Complete line of consulting engineering services for biomass and peat projects. From resources determinations through direct firing and peat and biomass carbonization.		
RECENT EXAMPLES	- East Africa - peat and biomass carbonization/combustion including carbonization to produce fuel briquettes. - SE USA - evaluation of use of peat for fuel purposes. - Saskatchewan - evaluation of peat resources including surveys and burn tests of peat in small combustors.		

COMPANY NAME	Monenco Consultants Ltd.		
ADDRESS	One St. Paul Street P.O. Box 1540 St. Catharines, Ontario L2R 7J9	TELEPHONE FAX TELEX	(416) 688-9263 (416) 688-0921 061-5219
CONTACT NAME	K.D. Hubley, P.Eng.		
DESCRIPTION OF SERVICES	Engineering, procurement and project and construction management and supervision. Energy audits and environmental assessments.		
RECENT EXAMPLES	- B.F. Goodrich, Niagara Falls, Ontario - preliminary engineering for addition of a condensing economizer to existing boilers. - H.J. Heinz, Leamington, Ontario - preliminary engineering for addition of a back pressure turbine cogeneration system to existing boilers. - Canada Packers, Toronto, Ontario - reviewed boiler performance and made recommendations on how to reduce steam loads.		

COMPANY NAME	Northland Power		
ADDRESS	250 Bloor Street East	TELEPHONE	(416) 962-6262
	Suite 1411	FAX	(416) 962-6266
	Toronto, Ontario	TELEX	
CONTACT NAME	Mr. Alex Juchymenko		
DESCRIPTION OF SERVICES	Development engineering, construction, operation of biomass systems, specializing in cogeneration.		
RECENT EXAMPLES	- 120 GJ/h wood residue-fired, high-pressure boiler produced steam for generation of electricity and supplies low pressure steam to adjacent sawmill for process requirements, Cochrane, Ontario.		

COMPANY NAME	The Proctor and Redfern Group		
ADDRESS	210 King Street	TELEPHONE	(416) 688-4272
	St. Catharines, Ontario	FAX	(416) 688-5812
	L2R 3J9	TELEX	
CONTACT NAME	Mr. David Schram		
DESCRIPTION OF SERVICES	General engineering consulting services; marketing studies, design and servicing of solid waste combustion systems; ash management and disposal; solidification systems, tender document preparation and evaluation.		
RECENT EXAMPLES	- Servicing and market study for a 100 tonne/day energy from solid waste-fired steam boiler system, ash management. - Feasibility studies for solid waste management: Metro Toronto, City of St. Catharines, Region of Sudbury, City of Windsor, City of Peterborough.		

COMPANY NAME	Sylva Energy Systems		
ADDRESS	519 Richard Street Thunder Bay, Ontario P7A 1R2	TELEPHONE FAX TELEX	(807) 683-6795
CONTACT NAME	Brian Aho/Terry Gunnell		
DESCRIPTION OF SERVICES	Consultants, planners and equipment suppliers for biomass energy recovery systems; including fuel preparation and handling systems, boiler house construction, district heating.		
RECENT EXAMPLES	- 1.3 GJ/h wood chip-fired, low-pressure boiler provides hot water for space heating at Wedgewood Manor, Summerside, PEI. - 1.8 GJ/h wood chip-fired, low-pressure boiler provides hot water for space heating at O'Leary High School and adjacent hospital, PEI. - 12.6 GJ/h, wood chip-fired, high-pressure 862 KPa boiler produces steam in a small district heating setup at the University of PEI, Charlottetown.		

COMPANY NAME	Triton Engineering Services Limited		
ADDRESS	51 Townline Orangeville, Ontario L9W 1V1	TELEPHONE FAX TELEX	(519) 941-0330
CONTACT NAME	Mr. R.J. Willcocks		
DESCRIPTION OF SERVICES	Advisory, predesign, preliminary and final design and construction administration; specializing in civil engineering.		
RECENT EXAMPLES	- Consulting engineers to the 1984 Orangeville WPLP expansion; design included enhanced biogas recovery and utilization by increasing methane gas production from digesters and utilizing it for plant and process heating of the WPLP plus electrical generation and district heating.		

PRINCE EDWARD ISLAND

COMPANY NAME	CBCL Limited		
ADDRESS	155 Belvedere Avenue Charlottetown, PEI C1A 7N4	TELEPHONE FAX TELEX	(902) 892-0303 (902) 368-3444
CONTACT NAME	N. MacLauchlan		
DESCRIPTION OF SERVICES	See listing for CBCL in Nova Scotia.		
RECENT EXAMPLES			

COMPANY NAME	Coles Associates Ltd.		
ADDRESS	197 Malpeque Road P.O. Box 695 Charlottetown, PEI C1A 7L3	TELEPHONE FAX TELEX	(902) 368-2300 (902) 566-3768
CONTACT NAME	D. Coles		
DESCRIPTION OF SERVICES	Electrical, mechanical, structural, heating duct design and engineering.		
RECENT EXAMPLES	- Small biomass and wood chip central heating plant for Confederation Centre of the Arts.		

COMPANY NAME	PEI Energy Corporation		
ADDRESS	P.O. Box 2000	TELEPHONE	(902) 368-4220
	Charlottetown, PEI	FAX	(902) 892-3420
	C1A 7N8	TELEX	014-44154
CONTACT NAME	R.J. Brandon		
DESCRIPTION OF SERVICES	Provincial Crown Corporation acting as a developer. Provide specifications and work with equipment suppliers.		
RECENT EXAMPLES	- 13 MW district heating system. - Wood-fired boilers for a hospital and school.		

QUEBEC

COMPANY NAME ADS Associes Ltee

ADDRESS
890 Boul. Charest East
Suite 400
Quebec, Quebec

TELEPHONE (418) 648-0858
FAX (418) 648-6757
TELEX

CONTACT NAME Mr. Pierre Turcot

DESCRIPTION OF SERVICES Civil, electrical, mechanical, structural, environmental engineering

RECENT EXAMPLES

- Hardwood waste-fired high pressure boiler (14 GJ/h) provides steam for process and space heating, Victoriaville.
- Instrumentation, startup and controls for the biosyn methanol (from wood waste) pilot plant, St. Juste de Bretonniere.

COMPANY NAME ADS Associes Ltee

ADDRESS
2155, Rue Guy, Bureau 1200
Montreal, Quebec
H3H 2L9

TELEPHONE (514) 932-4454
FAX (514) 932-1518
TELEX

CONTACT NAME Mr. Charles Lavoie

DESCRIPTION OF SERVICES General consulting engineering services, detailed process engineering.

RECENT EXAMPLES

- Hospital wastes are incinerated, hot combustion gases produced feed. An 8.75 GJ/h waste heat boiler that produces 3900 kg steam/h at 1034 KPa for space heating at L'Hopital Notre Dame, Montreal, Quebec.
- Currently engineering a preliminary engineering and financial feasibility study of two plants for the Communaute Regionale De L'Outaouais: one plant produces RDF from municipal waste, the second utilizes the RDF to produce steam for process heating.
- Hospital wastes are incinerated and the combustion gases feed a waste heat boiler to produce 100 kg of steam/h for space heating at the Montreal Children's Hospital, Montreal.

COMPANY NAME Bouthillette, Partlean & Associes

ADDRESS
9825, Rue Verville
Montreal, Quebec
H3L 3E1

TELEPHONE (514) 383-3747
FAX (514) 383-8760
TELEX

CONTACT NAME Mr. Rene Viav

DESCRIPTION OF SERVICES General consulting engineers

RECENT EXAMPLES

- Feasibility study for a 28.8 GJ/h wood residue-fired boiler for steam production for hospital use and heating at the Centre Hospitalier Region De L'Anaudiere, Quebec.
- Feasibility study for a 10.8 GJ/h wood residue-fired boiler for steam production for heating requirements at College Rigaud, Quebec.

COMPANY NAME GBGM Ltee, Groupe Conseil

ADDRESS
5355, Boul. Des Gradins
Quebec, Quebec
G2J 1C8

TELEPHONE (418) 623-2254
FAX (418) 622-1137
TELEX

CONTACT NAME Mr. Denis Fortin

DESCRIPTION OF SERVICES Mechanical and electrical consulting services.

RECENT EXAMPLES

- Wood residue-fired boiler that produces steam for space heating, Beauport, Quebec.

COMPANY NAME	Hatch & Associes (Quebec) Inc.		
ADDRESS	630 ouest, Boul. Dorchester	TELEPHONE	(514) 861-0583
	Bureau 1300	FAX	(514) 397-1651
	Montreal, Quebec	TELEX	05-267374
	H3B 1S6		
CONTACT NAME			
DESCRIPTION OF SERVICES	See Ontario - Hatch Associates Ltd.		
RECENT EXAMPLES			

COMPANY NAME	Les Consultants Jab Inc.		
ADDRESS	10087, Boul. St. Laurent	TELEPHONE	(514) 384-7122
	Montreal, Quebec	FAX	(514) 384-3723
	H3L 2N5	TELEX	
CONTACT NAME	Mr. Gerard/Mr. Gamasche		
DESCRIPTION OF SERVICES	Mechanical and electrical engineering specializing in plumbing, ventilation, heating and planning.		
RECENT EXAMPLES	- Feasibility study for a 2.1 GJ/h apple residue-fired boiler for production of low pressure steam for space heating at Les Industries F.P., Quebec. - Over 20 installations/conversions of conventionally-fired boiler systems.		

COMPANY NAME	Pageau, Morel & Associes Inc.		
ADDRESS	210, Cremazie Ouest Bureau 110 Montreal, Quebec H2P 1C6	TELEPHONE FAX TELEX	(514) 382-5150 (514) 384-9872
CONTACT NAME	Mr. John St. Pierre		
DESCRIPTION OF SERVICES	Mechanical and electrical consulting engineers.		
RECENT EXAMPLES	- 7.0 GJ/h sawdust-fired suspension boiler provides steam for space and process requirements at Berthier, Quebec.		

COMPANY NAME	Le Groupe SNC/The SNC Group		
ADDRESS	2, Place Felix-Martin Montreal, Quebec H2Z 1Z3	TELEPHONE FAX TELEX	(514) 866-1000 (514) 866-0795 055-60042
CONTACT NAME	Mr. Gilles Fournier		
DESCRIPTION OF SERVICES	General consulting engineering, process detailed design, construction engineering.		
RECENT EXAMPLES	- Consulting engineers for wood residue gasifiers (including fuel preparation and handling systems): wood residues supply gas for generation of 7 MW of electricity from a diesel engine in French Guyana; consultants to the 15 tonne/h, 3MW generating demonstration gasifier plant at St. Juste De Bretonniere, Quebec.		

COMPANY NAME Sandwell Swan Wooster Inc.

ADDRESS
455 Boulevard Rene-Levesque Ouest
Montreal, Quebec

TELEPHONE (514) 866-1221
FAX (514) 866-1221 Ext. 136
TELEX 05-25151

CONTACT NAME

DESCRIPTION OF SERVICES General consulting engineering services.

RECENT EXAMPLES

- 130 tonnes/h wood residue-fired boiler produces high pressure steam for process and heating requirements at the Windsor Domtar Mill, Quebec.
- Wood residue-fired boiler produces 100 tonnes high pressure steam/h for process requirements at the Amy Donahue/Normick Mill in Amus, Quebec.
- Wood residue-fired boiler produces 226 tonnes high pressure steam/h for cogeneration at St. Felicionne, Quebec.

COMPANY NAME H.A. Simons Limited

ADDRESS
2001, Rue University
6 ieme Etage
Montreal, Quebec
H2A 2A6

TELEPHONE (514) 284-3676
FAX (514) 284-0153
TELEX

CONTACT NAME Mr. George Gellatly

DESCRIPTION OF SERVICES General engineering specializing in the forest products industry.

RECENT EXAMPLES

- 210 GJ/h wood residue-fired high pressure (90,700 kg/h) boiler to produce steam for cogeneration of electricity and steam for process engineering, Fraser Pulp and Paper Mill, Edmunston, N.B.
- 263 GJ/h wood residue-fired boiler for cogeneration of electricity and steam, Irving Pulp and Paper, St. John, N.B.
- Pressed clarifier sludge and thermal mechanical pulping is co-fired with bark and wood residues to produce steam for process requirements at Donahue Inc. Pulp and Paper, Clairmont.

COMPANY NAME	Sinki Consultant Inc.		
ADDRESS	4175 Maudassant	TELEPHONE	(514) 445-1589
	Brossard, Quebec	FAX	(514) 445-1589
	J4Y 1S8	TELEX	
CONTACT NAME	Gamel Sinki		
DESCRIPTION OF SERVICES	Energy feasibility studies, preparation of plans and estimates; management and design of industrial thermal heat recovery projects.		
RECENT EXAMPLES	- Energy feasibility study, heat recovery from the kiln surrounding air, heat recovery from Clinkor Cooler for building heating, for preheating of primary air of combustion, and for the substitution of process pre-heating of the raw material by natural gas; Canada Cement Lafarge Limited. - Energy feasibility studies including heat recovery from the anodizing plant air exhausters, conversion of billet oven to induction heating, thermal liquid heating, heat recovery from spray booth and paint over, solvent incineration and solvent recovery process; Zimmcor Company. - Study to recover heat from the refrigeration system, study concerning the heat recovery of evaluation water, Milk Division of Agropur.		

COMPANY NAME	Tecsult Inc.		
ADDRESS	85 Ouest, Rue Ste.-Catherine	TELEPHONE	(514) 287-8500
	Bureau 1500	FAX	(514) 287-8643
	Montreal, Quebec	TELEX	
	H2X 3P4		
CONTACT NAME	Mr. Daniel Marquis		
DESCRIPTION OF SERVICES	General consulting engineering.		
RECENT EXAMPLES	- Sludge-fired incinerator/waste heat boiler system (4 at 13 tonnes steam/h) that provides high pressure 1034 kPa steam for space heating and refrigeration of main electric motors in the pumping station; East Montreal, Quebec.		

COMPANY NAME	Tecsult Inc.		
ADDRESS	4700 Boul. Hamel Quebec, Quebec G1P 2J9	TELEPHONE FAX TELEX	(418) 871-2452 (418) 871-5868
CONTACT NAME	Mr. Denis Roussel		
DESCRIPTION OF SERVICES	General consulting engineers.		
RECENT EXAMPLES	- Wood residues fire a boiler to produce high pressure steam for process and space heating at the Neweago Lumber Mill, Mead, Ontario.		

COMPANY NAME	Urgel Delisle et Associes		
ADDRESS	C.P. 60 426 Chemin des Patriotes St-Charles-sur-Richelieu Quebec	TELEPHONE FAX TELEX	(514) 584-2207 (514) 584-2523
CONTACT NAME	Michel S. Cournoyer		
DESCRIPTION OF SERVICES	Studies, plans and specifications for biogas digestors using manure.		
RECENT EXAMPLES	- 600 m^3 digestor permitting the treatment of manure of 350 milk cows. - Research project for the feasibility of this digestor financed by Agriculture Canada. Study included plans, specifications and site reconnaissance. - Research project for the complete automation of this project (financed by Agriculture Canada).		

SASKATCHEWAN

COMPANY NAME	Angus, Butler Engineering Ltd.		
ADDRESS	1112 Morgan Avenue Saskatoon, Saskatchewan S7H 2R7	TELEPHONE FAX TELEX	(306) 477-1113 (306) 373-5045
CONTACT NAME	J.M. Helfrich		
DESCRIPTION OF SERVICES	Mechanical and electrical engineering. Studies, evaluations, design, supervision and project management.		
RECENT EXAMPLES	- Generator building and heat recovery system for Cluft Mining. - Standby generation equipment for St. Paul's University Hospital. - Propane conversion study for Cluft Mining.		

COMPANY NAME	The Cambrian Engineering Group Ltd.		
ADDRESS	119 - 105th Street East Saskatoon, Saskatchewan S7N 1Z2	TELEPHONE FAX TELEX	(306) 374-8242 (306) 374-0909
CONTACT NAME	E.J. Hinz		
DESCRIPTION OF SERVICES	- Multidisciplinary industrial consulting. - Technical and economic feasibility studies, conceptual design, preliminary engineering, value engineering, commissioning and start-up assistance.		
RECENT EXAMPLES	- Heat recovery on waste water system, boiler stacks and exhaust air for Union Hospital. - Mine heating application utilizing exhaust air for Eldor Mines. - Exhaust air heat recovery system for Prairie Malt Canada Ltd.		

COMPANY NAME	Cochrane Lavalin Inc.		
ADDRESS	Suite 200 1230 Blackfoot Drive Regina, Saskatchewan S4S 7G4	TELEPHONE FAX TELEX	(306) 585-1990 (306) 586-9113
CONTACT NAME	R.D. Farrell		
DESCRIPTION OF SERVICES	Mechanical, electrical, structural - full range of services for institutional, commercial and industrial clients.		
RECENT EXAMPLES	- Energy audit programs for the federal government to improve energy efficiency. - Design of the heating ventilating system for Epsco.		

COMPANY NAME	Epec Consulting (Sask.) Ltd.		
ADDRESS	1500 - 4th Avenue Regina, Saskatchewan S4R 8G8	TELEPHONE FAX TELEX	(306) 757-8694 (306) 781-7265
CONTACT NAME	D.R. Blakley or J.W. Campbell		
DESCRIPTION OF SERVICES	Multidisciplinary engineering services.		
RECENT EXAMPLES	See Boreal Consulting Services Ltd., Yukon (affiliate).		

COMPANY NAME	Engineering Management Services - Croscan Limited		
ADDRESS	P.O. Box 4042 Saskatoon, Saskatchewan S7K 3T1	TELEPHONE FAX TELEX	(306) 665-9090
CONTACT NAME	D.J. Kishchuk		
DESCRIPTION OF SERVICES	- Mechanical and industrial engineering for commercial and institutional buildings. - Energy conservation work, cost estimates, preliminary planning, feasibility studies.		
RECENT EXAMPLES	Selected and sized boilers for the Saskatoon Transit facility bus terminal building.		

COMPANY NAME	Saskmount Engineering		
ADDRESS	410 McDonald Street Regina, Saskatchewan S4N 6E1	TELEPHONE FAX TELEX	(306) 924-0770 (306) 721-2065
CONTACT NAME	B.G. Zytaruk		
DESCRIPTION OF SERVICES	All engineering disciplines - evaluations, design, project supervision.		
RECENT EXAMPLES	- Coal-fired power generator for Saskatchewan Power Corp. - Boilers for commercial buildings and shopping malls.		

COMPANY NAME	Yoneda and Associates Ltd.		
ADDRESS	600 - 2201 - 11th Avenue	TELEPHONE	(306) 757-0630
	Regina, Saskatchewan	FAX	(306) 781-7078
	S4P 0J6	TELEX	
CONTACT NAME	J.B. Huntington		
DESCRIPTION OF SERVICES	Energy budgets and design of energy systems.		
RECENT EXAMPLES	- Study of energy efficient building for the National Research Council. - Heat recovery projects for the energy centres at Pasqua and General Hospitals in Regina. - Heat recovery at a processing facility for Davy Cooperative Ltd.		

YUKON

COMPANY NAME Boreal Consulting Services Ltd.

ADDRESS
207 Strickland Street
Whitehorse, Yukon
Y1A 2J7

TELEPHONE (403) 667-6327
FAX (403) 668-2734
TELEX

CONTACT NAME L. Whelan or D.C. McLaughlin

DESCRIPTION OF SERVICES Full consulting services available - feasibility, design, construction and implementation.

RECENT EXAMPLES

- Design of energy recovery systems for Yukon government.
- Study of various plants to burn waste oil for N.W.T. government.
- Energy feasibility study for Total Forest Products and the nearby area around Whitehorse.

COMPANY NAME D.W. Thomson Consultants Ltd.

ADDRESS
312B Hanson Street
Whitehorse, Yukon
Y1A 1Y6

TELEPHONE (403) 668-5525
FAX (403) 668-4456
TELEX

CONTACT NAME K. Shuler

DESCRIPTION OF SERVICES Evaluation of economics and design of heating systems.

RECENT EXAMPLES

- Firetube boiler using wood chips at the Law Court building in Whitehorse.
- Selected a fluidized bed boiler and designed the heating system using coal, wood chips and paper as fuel for Yukon College in Whitehorse.

APPENDIX I

SAMPLE QUESTIONNAIRES

Combustion System Information

A. Company Data

Company Name:____

Company Address:____

____

____

Telephone:____________________ Telex:___________________

Contact:____

Contact Position:____

Company is a: manufacturer_____ supplier_____

Canadian Representatives/distributors(if any):

____

____

____

____

Parent Company:____

____

B. System Description (for each product line)

System Name:_________________________________

Sizes Available:_____________________________ (0.2-21 GJ/h range)
(200,000-20,000,000 Btu/h)

Energy Form: hot gas ___ hot water ___ hot oil ___ steam ___

other ____

____

	smallest model	largest model
Input Capacity: (fuel input)	______________________	______________________
Dimensions:	______________________	______________________
Weight:	______________________	______________________

C. Fuel Requirements

Fuel Type: hog fuel ___ sawdust ___ wood chips ___

small log ___ MSW ___ agricultural waste ___

other ____

Size Constraints: min ____ max ________ recommended __________

Moisture Constraints: max (wet basis) _______ recommended ________

Other Limitations: ____

____

____

Auxiliary Fuel Requirements: ______________________________________

____

____

Electricity Requirements: ____

D. Ancillary Equipment
Please describe briefly provisions included with the system for:

Fuel Storage & Handling ____

____

____

Emissions Control ____

____

____

Ash Handling ____

____

____

Control Instrumentation ____

____

____

E. System Cost:
basic combustor: smallest unit___________ largest unit___________

turnkey system: smallest unit___________ largest unit___________

A CATALOGUE OF SMALL SCALE COMBUSTORS FOR BIOMASS FUELS

LISTING OF CONSULTANTS

The following information has been compiled from existing information sources for a "Catalogue of Small Scale Combustors for Biomass Fuels" currently being assembled by Ensyn Engineering Associates Inc for the federal Department of Energy Mines and Resources. The Guide is for small combustors in the range of 0.1 to 21 GJ/hr. If your firm has actively been providing services for equipment in this range please take time to fill out and return the short questionnaire below.

COMPANY NAME: ______________________________

FULL ADDRESS: ______________________________

____

TELEPHONE: ______________

FAX: ______________ TELEX: ______________

CONTACT PERSON FOR SMALL COMBUSTORS: ______________________________

DESCRIPTION OF SERVICES: ______________________________

____

____

RECENT EXAMPLES OF CONSULTING FOR SMALL COMBUSTORS 0.1 to 21 GJ/hr: (Use separate pages as necessary)

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

BRANCH OFFICES PROVIDING SIMILAR SERVICES:

____

____

Please return to :
ENSYN ENGINEERING LTD. - CONSULTANT BIOMASS LISTING
2610 DEL ZOTTO AVENUE,
RR #5 GLOUCESTER
ONTARIO, KIG 3N3 TEL. (613) 822-1835

F. Commercial Installations (North America):

1. ____

____

2. ____

____

3. ____

____

* Note: Please include descriptive technical brochures and literature if available.